Right Heart Catheterization from the Arm

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Associate Professor of Medicine
Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

<table>
<thead>
<tr>
<th>Affiliation/Financial Relationship</th>
<th>Company</th>
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<tbody>
<tr>
<td>Grant/Research Support</td>
<td>Regado Biosciences / Astra Zeneca</td>
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<tr>
<td>Consulting Fees/Honoraria</td>
<td>Abiomed / Terumo Medical / Accumed / Medtronic / Edwards Lifesciences / The Medicines Company / Merritt Medical</td>
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<tr>
<td>Major Stock Shareholder/Equity</td>
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<tr>
<td>Royalty Income</td>
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<td>Ownership/Founder</td>
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<tr>
<td>Intellectual Property Rights</td>
<td>None</td>
</tr>
<tr>
<td>Other Financial Benefit</td>
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Why Do we Need to Talk about RHC at this Meeting?

• The need for RHC is one of the most frequent excuses for not performing radial access
• Not everything is about PCI in the Cath Lab
  – Cardiomyopathies
  – Intracardiac shunts
  – Assessment of valvular and structural heart disease
  – Radialists to have a role in the delivery of stroke prevention devices in TAVR
  – Assessment of pulmonary hypertension
Arm Veins: Original Cardiac Access

source: Ian Gilchrist, MD

Forssmann *Klinische Wochenschrift* 1929;8(45)2085-7.
There is room for a safer way to the right heart & central venous system

Access: Radial artery
RIJ vein

Complication: Pneumothorax

source: Ian Gilchrist, MD
A Sad Story

- 63 yo Female
- Hepatitis C cirrhosis
- Diabetes, hypertension
- Ascites, hepatic encephalopathy, Esophageal varices
- Echocardiography: mild elevation RVSP
- Cardiac catheterization:
  - Right radial access, Right femoral venous access
  - Mild coronary irregularities, PAP: 41/14 (25) mmHg
  - Small groin hematoma
General Rules

• Extreme anatomic variability
  – Collaterals
  – Redundant passages
• Veins relatively distensible
• Low pressure vs arterial
• Venous spasm
  – Less likely with soft catheters
  – Not usually a problem
  – Use nitrates, not Ca++ blocker
Radial (lateral) veins lead equally to either Cephalic or Basilic veins.

Ulnar (medial) veins usually continue as Basilic vein.

source: Ian Gilchrist, MD
Technique

- Venous access was obtained, by nurses in the preprocedural holding area, using a 20-gauge or larger lumen angiocath that was then heparin-locked.
- In the cardiac catheterization laboratory, the angiocath was then exchanged for a venous access sheath over a wire.
- Size 5-French sheaths were typically used in the venous system with 120-cm or 110-cm balloon wedge catheters.
Left/Right Heart Procedures  Femoral vs Radial

Procedural Time

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femoral</td>
<td>75±5.4</td>
</tr>
<tr>
<td>Radial</td>
<td>70±5.0</td>
</tr>
</tbody>
</table>

Arterial Time

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femoral</td>
<td>45±6.3</td>
</tr>
<tr>
<td>Radial</td>
<td>35±4.2</td>
</tr>
</tbody>
</table>

Less radiation time  p<.001

### Left/Right Heart Procedures  *Femoral vs Radial*

<table>
<thead>
<tr>
<th>Complications</th>
<th>Femoral n=175</th>
<th>Radial n=105</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV Fistula</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Pseudoaneurysm</td>
<td>4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hematoma</td>
<td>6</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Anticoagulated Arms vs Routine Femoral Procedures

<table>
<thead>
<tr>
<th></th>
<th>Arm (n=28)</th>
<th>Femoral (n=31)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success (%)</td>
<td>96</td>
<td>100</td>
</tr>
<tr>
<td>Procedure Time (min)</td>
<td>48(P&lt;0.05)</td>
<td>32</td>
</tr>
<tr>
<td>X-Ray Time (min)</td>
<td>10.5</td>
<td>8</td>
</tr>
<tr>
<td>Radiation (cGycm2)</td>
<td>33.9</td>
<td>31</td>
</tr>
</tbody>
</table>

Arm access outside of cath lab
Might improve this difference?
82 consecutive patients with ESLD cathed via transradial access between 02/01/2008 and 07/31/2010

**Safety of Transradial Cardiac Catheterization in Patients with End-Stage Liver Disease**

Evan Jacobs,¹ MD, Vikas Singh,¹ MD, Abdulla Damluji,¹ MD, MPH, Neil R. ¹ ¹ ¹ ¹
Jessica L. Warsch,¹ MD PhD, Ravi Ghanta,² MD, Paul Martin,² MD, Carlos E. ¹ ¹ ¹ ¹ ¹
Claudia A. Martinez,¹ MD, Mauro Mosucci,¹ MD, and Mauricio G. Coll ¹ ¹ ¹ ¹ ¹

<table>
<thead>
<tr>
<th>Variable</th>
<th>Median (25th, 75th)</th>
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<tbody>
<tr>
<td>Age (yrs)</td>
<td>59 (54, 66)</td>
</tr>
<tr>
<td>Female gender</td>
<td>42 (%)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.3 (22.9, 31.5)</td>
</tr>
<tr>
<td>MELD Score</td>
<td>19 (13, 24)</td>
</tr>
<tr>
<td>Glomerular filtration rate (mL/min)</td>
<td>35.5 (22, 47)</td>
</tr>
<tr>
<td>Baseline creatinine (mg/dL)</td>
<td>1.1 (1, 1.5)</td>
</tr>
<tr>
<td>Hemoglobin (g/dL)</td>
<td>10.6 (9.4, 11.8)</td>
</tr>
<tr>
<td>Hematocrit (%)</td>
<td>30.8 (27.4, 33.9)</td>
</tr>
<tr>
<td>Platelet Count (x 10⁶/L)</td>
<td>74 (52, 118)</td>
</tr>
<tr>
<td>Prothrombin time (sec)</td>
<td>14.2 (12.1, 17.6)</td>
</tr>
<tr>
<td>INR</td>
<td>1.4 (1.2, 1.8)</td>
</tr>
<tr>
<td>APTT (sec)</td>
<td>36 (32, 42)</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Brachial</th>
<th>Femoral</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n=45)</td>
<td>(n=37)</td>
<td></td>
</tr>
<tr>
<td>Fluoroscopy time (min)</td>
<td>8.2</td>
<td>7.4</td>
</tr>
<tr>
<td>Hb drop at 24 h (g/dL)</td>
<td>0.1 (0, 0.4)</td>
<td>0.3 (0, 1.0)</td>
</tr>
</tbody>
</table>

Jacobs E, et al. CCI 2014;83:360–366
Nurse places heparin lock in forearm for use in the catheterization lab for venous sheath access.

- saves time
- improves cath lab efficiency
- fosters team building

source: Ian Gilchrist, MD
Venous Anatomy can be Unpredictable

The IV placed by the nurse may not work. Need backup plan
Venipuncture can be a challenge!!
Difficult venous access

- Ultrasound guided venous access
  - Safe
  - Easy to learn
  - Usually available
  - No added radiation burden
Access Technique

- Apply tourniquet
- Use real-time ultrasound
Ultrasound Images
Right Heart Catheterization via Antecubital Vein
Right Heart Catheterization via Antecubital Vein
A Technique to Access Difficult to Find Upper Extremity Veins for Right Heart Catheterization: The Levogram Technique

Samir B. Pancholy, MD, FACC, FSCAI and Joseph Sweeney, RT (R, CV)

Apply tourniquet, inject contrast in the artery and wait for the venous phase to stick
Levophase venogram
Venous puncture
Sheath insertion
Right Heart Catheters (4-8 F available)

5F-Edwards Lifescience TS105F5

4F-Arrow Balloon Wedge AI-07122

105 cm

110 cm

source: Ian Gilchrist, MD
If You Access the Cephalic Vein...

• Do not push!
• Do not inflate balloon in cephalic
• Inspiration may change angle & enhance central flow
• A coronary wire may be useful
• Confirm with venogram
Cephalic vein joins the Axillary vein at a *T-Junction*.  
- Defines start of the subclavian & central venous system  
- Location most likely to cause technical issues
Navigating Tortuous Veins
Navigating Tortuous Veins

Using the back of the wire for better torque control
It’s Okay to do it in the Presence of an Ipsilateral Device, but...
And Some Times, you Just Can’t Do it!!
A 0.025” or 0.035” wire can be helpful
It is a good skill to have...

- 77 yo Lady from Naples, FL
- Dizziness
- Presyncope
- Chest heaviness
- Dyspnea on exertion
It is a good skill to have...
It is a good skill to have...
Nurse Able to Obtain IV Access with 20G Angiocath

No

- Call IV Team to place a small sheath under U/S
  - Yes
    - Cath Lab
  - No
    - Team Busy
      - Yes
        - U/S-guided venous access in Cath Lab
          - Right Heart Catheterization
    - No
      - Angiocath exchange over a wire possible
        - Yes
          - Cath Lab
        - No
Contraindications/Cautions

Obstruction to drainage
- Radial breast surgery
- Trauma
- SVC disease

Prior brachial cutdown
EP devices
No visible veins

source: Ian Gilchrist, MD
Conclusions

- RHC is a key diagnostic procedure in the cath lab
- Femoral or Internal Jugular access associated with complications
- RHC through the arm is easy to perform and can be incorporated in the cath lab workflow