• Case 1: 75 yr old female admitted with chest pain and abnormal stress test

• Case 2: 70 yr F with typical exertional angina and HTN, dyslipidemia.
Trans Radial Intervention
Problems at the passage

Kintur Sanghvi MD

March 15, 2007
In 1989 Lucien Campeau published “Percutaneous radial artery approach for coronary angiography” 
CCVD 1989;16:3-7

100 patients
5F catheters
12 failures
1% radial artery occlusion
0% major bleeding
Radial anatomy

This is explained by the favorable anatomical characteristics of the radial artery:
1. Superficial course
2. Surrounded by bony or tendineous structures
3. Separated from major veins and nerves
4. Double blood supply to the hand

2004
Cardiology department,
SVCMC
Allen’s test

Patel’s Atlas on Trans radial intervention – The basics

Cardiology department, SVCMC
Interpretation of Allen’s

Patel’s Atlas on Trans radial intervention – The basics
Inverse Allen’s test

- To determine patency of the radial artery
- Useful for repeat procedure from the same RA
- If Inverse Allen’s is negative (abnormal) RA I not suitable for repeat procedure.
Alternative (Objective) Allen’s test

Patel’s Atlas on Trans radial intervention – The basics

Cardiology department, SVCMC
Puncture site and position of wrist

Patel’s Atlas on Trans radial intervention – The basics

Cardiology department, SVCMC
Radial puncture

Patel’s Atlas on Trans radial intervention – The basics

Cardiology department, SVCMC
Radial puncture
Radial puncture
Terumo band

Patel’s Atlas on Trans radial intervention – The basics

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Radial

Essentially no bleeding risk

Femoral

3.2-14% bleeding risk*

* Popma, Circ.1993;88:1569-78.
Transradial Intervention

Advantages.

- Nearly 0% local site complication.
- Better quality of life for the patients and the staff.
- Reduce cost.
- Same day discharge.
- All coronary and peripheral vascular interventions are possible except for few exceptions.

Limitations: Technically difficult:

- Access failure.
- Radial spasm.
- Loops and tortuosity of Radial and Subclavian.
- Longer learning curve

Cardiology department, SVCMC
MACE Radial vs Femoral

### Table: MACE (Death, MI, Revasc, stroke)

<table>
<thead>
<tr>
<th>Study or sub-category</th>
<th>Radial n/N</th>
<th>Femoral n/N</th>
<th>OR (random) 95% CI</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grinfield</td>
<td>0/138</td>
<td>2/141</td>
<td>0.20 [0.01, 4.23]</td>
<td>1996</td>
</tr>
<tr>
<td>Mann 1996</td>
<td>1/76</td>
<td>0/76</td>
<td>3.04 [0.12, 75.80]</td>
<td>1996</td>
</tr>
<tr>
<td>ACCESS</td>
<td>20/300</td>
<td>16/300</td>
<td>1.27 [0.64, 2.50]</td>
<td>1997</td>
</tr>
<tr>
<td>BRAFE Stent</td>
<td>3/56</td>
<td>2/56</td>
<td>1.53 [0.25, 9.52]</td>
<td>1997</td>
</tr>
<tr>
<td>Mann 1998</td>
<td>0/74</td>
<td>0/68</td>
<td>Not estimable</td>
<td>1998</td>
</tr>
<tr>
<td>Cooper</td>
<td>0/101</td>
<td>1/99</td>
<td>0.32 [0.01, 8.04]</td>
<td>1999</td>
</tr>
<tr>
<td>Moncégu</td>
<td>0/196</td>
<td>0/183</td>
<td>Not estimable</td>
<td>2000</td>
</tr>
<tr>
<td>CARAFE</td>
<td>0/140</td>
<td>0/70</td>
<td>Not estimable</td>
<td>2001</td>
</tr>
<tr>
<td>Gorje</td>
<td>0/214</td>
<td>0/216</td>
<td>Not estimable</td>
<td>2001</td>
</tr>
<tr>
<td>Moriyama</td>
<td>0/108</td>
<td>1/92</td>
<td>0.28 [0.01, 6.98]</td>
<td>2002</td>
</tr>
<tr>
<td>OCTOPLUS</td>
<td>5/188</td>
<td>6/183</td>
<td>0.60 [0.12, 1.06]</td>
<td>2003</td>
</tr>
<tr>
<td>TEMPURA</td>
<td>6/77</td>
<td>8/72</td>
<td>0.68 [0.22, 2.05]</td>
<td>2003</td>
</tr>
</tbody>
</table>

Total events: 35 (Radial), 38 (Femoral)
Test for heterogeneity: Chi² = 4.43, df = 7 (P = 0.73)
Test for overall effect: Z = 0.34 (P = 0.73)

JACC 2004; 44:349-56

Cardiology department,
SVCMC
Transradial Intervention

Radial Vs Femoral approach for diagnostic and PCI procedures: Systemic overview and meta-analysis
12 randomized trials n = 3234 (J Am Coll Cardiol 2004 44: 349-356)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Radial number</th>
<th>Femoral number</th>
<th>OR (random) 95% CI</th>
<th>OR (random) 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure failure</td>
<td>107/1472</td>
<td>33/1373</td>
<td>3.30 (1.63, 3.71)</td>
<td></td>
</tr>
<tr>
<td>Entry site Complication</td>
<td>5/1472</td>
<td>39/1373</td>
<td>0.20 (0.09, 0.42)</td>
<td></td>
</tr>
<tr>
<td>Major Adverse Cardiac event MACE</td>
<td>35/1668</td>
<td>38/1556</td>
<td>0.92 (0.57, 1.48)</td>
<td></td>
</tr>
</tbody>
</table>

Favours Radial                      Favor Femoral

Cardiology department, SVCMC
TRI meta analysis

OR 0.20; p<0.0001; 0.3% vs 2.8%

5 of 1,472 patients
1 brachial artery perforation
1 AVF
1 hematoma >3 cm
2 femoral complications (cross overs)

} 0.2%

P. Agostoni et al- JACC 2004;44:349-56

Cardiology department, SVCMC
# Femoral complication rate

<table>
<thead>
<tr>
<th>COMPLICATION</th>
<th>%</th>
<th>NO. of PATIENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thrombosis (Z.kardiol 1994)</td>
<td>0.13 %</td>
<td>26,245</td>
</tr>
<tr>
<td>Large Pseudo-aneurysm (Int Angiol 1996)</td>
<td>1.0 %</td>
<td>8,715</td>
</tr>
<tr>
<td>AV Fistula (JACC- 2002)</td>
<td>0.86 %</td>
<td>10,271</td>
</tr>
<tr>
<td>Need of Transfusion* (JACC- 2001)</td>
<td>2.7 %</td>
<td>6,408</td>
</tr>
<tr>
<td>Retro-peritoneal Hemorrhage* (Ann Surg 1993)</td>
<td>0.15 %</td>
<td>7,334</td>
</tr>
<tr>
<td>Vascular Surgery (Wien Kliw Wochenschr 1996)</td>
<td>0.52 %</td>
<td>15,460</td>
</tr>
<tr>
<td>Leg Amputation (Radiology 1981)</td>
<td>0.01 %</td>
<td>83,068</td>
</tr>
</tbody>
</table>

Cardiology department, SVCMC
# Radial Vs femoral comparison

## TRI: Absence of Major Vascular Complications

<table>
<thead>
<tr>
<th>Major vascular complications</th>
<th>RADIAL</th>
<th>FEMORAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiemeneij F et al J Am Coll Cardiol 1996</td>
<td>0</td>
<td>2%</td>
</tr>
<tr>
<td>Tift Mann et al J Invas Cardiol 1996</td>
<td>0</td>
<td>4%</td>
</tr>
<tr>
<td>Ziakas A et al Am J Cardiol 1998</td>
<td>0</td>
<td>1.5%</td>
</tr>
<tr>
<td>Tift Mann et al J Am Coll Cardiol 1998</td>
<td>0</td>
<td>4%</td>
</tr>
<tr>
<td>Choussat R et al Eur Heart J 2000</td>
<td>0</td>
<td>4.5%</td>
</tr>
<tr>
<td>Hildic S et al Catheter Cardiovasc Interv 2000</td>
<td>0</td>
<td>6%</td>
</tr>
<tr>
<td>Louvard Y et al Catheter Cardiovasc Interv 2002</td>
<td>0</td>
<td>1.3%</td>
</tr>
<tr>
<td>Saito S et al Catheter Cardiovasc Interv 2002</td>
<td>0</td>
<td>3%</td>
</tr>
<tr>
<td>Valsecchi O et al Ital Heart J 2003</td>
<td>0</td>
<td>1.2%</td>
</tr>
<tr>
<td>Philippe F et al Catheter Cardiovasc Interv 2003</td>
<td>0</td>
<td>5.5%</td>
</tr>
<tr>
<td>Lefevre T (TCT 2003)</td>
<td>0</td>
<td>2.3%</td>
</tr>
<tr>
<td>Pooled data</td>
<td>0</td>
<td>3.8%</td>
</tr>
</tbody>
</table>
TRI current failure rate

Meta analysis

Radial failure = 1.9%

if the OCTOPLUS study is excluded
(pts > 80 yrs; RF 10.6%; FF 0.3%)

P. Agostoni et al- JACC 2004;44:349-56
Heterogeneity testing

- Showed a significant deviation from the assumption of statistical homogeneity for procedural failure (not for MACE and entry site complications):
  
  \[
  \text{Chi-square 18.71; df=10; p=0.044}
  \]

- Due to initial learning curve, temporarily favoring the femoral technique, followed by a progressive equalization through the years

- Studies performed after 1999 did not show a difference in procedural failure (OR 1.39; 3.9% versus 2.9%; p=0.3)

2004

P. Agostoni et al- JACC 2004;44:349-56
TRI learning curve

Volume in relation to procedural time and technical failure

- Procedural time (min.)
- Technical failure (%)

2004

Y. Louvard et al

Cardiology department, SVCMC
# Radial Learning curve

<table>
<thead>
<tr>
<th></th>
<th>&lt;80 Patients</th>
<th>&gt; 80 Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access failure</td>
<td>14%</td>
<td>2%</td>
</tr>
<tr>
<td>Sheath insertion time</td>
<td>$10.2\pm7.6$ min</td>
<td>$2.8\pm2.5$ min</td>
</tr>
<tr>
<td>Procedure time</td>
<td>$25.7\pm12.9$ min</td>
<td>$17.4\pm4.7$ min</td>
</tr>
</tbody>
</table>

*Spaulding et al CCI 39:365, 1996*

Cardiology department, SVCMC
TRI causes of failure

Reasons for failure:
- Puncture
- Cannulation
- PCI

Trend towards success:
- Dedicated materials: needles, sheaths, guides, hemostasis devices
- Cocktails and spasm reduction: ntg, verapamil, adenosin
- Dedicated guides: Boston, Cordis, Medtronic, Terumo
- Early training: residents and fellows
Effect of transradial access on quality of life and cost of cardiac catheterization: A randomized comparison

AHJ Volume 138, Issue 3, Pages 430-436 (September 1999)

- Methods and Results:
- randomized single-center trial – 99 TF and 101 TR diagnostic cath. Quality of life was measured with the SF-36 and visual analog scales
- TR significantly reduced median length of stay (3.6 vs 10.4 hours, $P < .0001$).
- measures of bodily pain, back pain, and walking ability favored the transradial group ($P < .05$ for all comparisons).
- There was a strong patient preference for transradial catheterization as well ($P < .0001$).
- significant reductions in costs ($2010 vs $2299, P < .0001$)
Christopher K Cooper al published a study of 200 patients in Am Heart J 1999 on patients preference for catheterization patients strongly preferred radial over femoral route as method of choice.

Patient preference for catheterization method rated on

- Strongly Prefer Radial
- No Preference
- Strongly Prefer Femoral

Number of Patients

*p < 0.0001

Christopher J. Cooper et al Am Heart J 1999
Cost shall include complication also

<table>
<thead>
<tr>
<th>Complication</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myocardial Infarction</td>
<td>$4,084</td>
</tr>
<tr>
<td><strong>Bleeding Complication</strong></td>
<td>$6,300</td>
</tr>
<tr>
<td>Repeat PCI</td>
<td>$8,187</td>
</tr>
<tr>
<td>In-Hospital CABG</td>
<td>$29,056</td>
</tr>
</tbody>
</table>

TRA The real drive through

- In the cath-lab full dressed patients, also during PCI
- Chairs instead of beds
- Personal video, audio and internet
- Private corners
- Reading table
- Wide screen TV corner
- Information, preparation and discharge by NP
- 4 hrs post procedure stay
Most of the procedure can be done by TRA

The Distribution of Radial Artery Diameter

Cumulative Frequency of Radial Artery Inner Diameter

Female

Male

6Fr

7Fr

8Fr

Radial Artery Diameter (mm)

% Cumulative Frequency

0 20 40 60 80 100

Cardiology department,
SVCMC
Sure we do right heart catheterization
Cardiology department, SVCMC

**Catheter-related peripheral embolism**

**Predictors of aortic debris**

- **Case-control Study**
  - 125 aortic debris
  - 152 no debris

**Age Groups**

- **60-69**
  - OR: 1

- **70-79**
  - OR: 2.4 [1.0-5.6], p < 0.005

- **> 80**
  - OR: 6.8 [2.1-21.9], p = 0.0001

**Other Predictors**

- HT (OR 2.5)
- Chol (OR 3.8)
- Smoking (OR 2.9)
- CAD (OR 2.3)
- PAD (OR 6.3)

*Karalis et al. Am Heart J 1996; 131: 1149-56*
Aortic Atheroma
Frequency and distribution of atherosclerotic plaques within the thoracic aorta in patients with CAD

<table>
<thead>
<tr>
<th>Location of aortic plaques</th>
<th>CAD (n = 97)</th>
<th>No CAD (n = 55)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descending Aorta</td>
<td>90 (93%)</td>
<td>12 (22%)</td>
<td>&lt;0.000001</td>
</tr>
<tr>
<td>Aortic Arch</td>
<td>77 (80%)</td>
<td>8 (19.5%)</td>
<td>&lt;0.000001</td>
</tr>
<tr>
<td>Ascending Aorta</td>
<td>36 (37%)</td>
<td>0</td>
<td>&lt;0.00014</td>
</tr>
</tbody>
</table>

Khoury Z Am J Cardiol 1997; 79: 23-27
Frequency and distribution of atherosclerotic plaques within the thoracic aorta in patients with CAD

<table>
<thead>
<tr>
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<th>CAD (n = 97)</th>
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</thead>
<tbody>
<tr>
<td>Descending Aorta</td>
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<td>Aortic Arch</td>
<td>77 (80%)</td>
</tr>
<tr>
<td>Ascending Aorta</td>
<td>36 (37%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Severity of atherosclerotic plaques / CAD</th>
<th>No plaques (grade I)</th>
<th>Simple (grade II)</th>
<th>Complex (grades III&amp;IV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descending Aorta</td>
<td>7 (7%)</td>
<td>34 (35%)</td>
<td>56 (58%) [47-68]</td>
</tr>
<tr>
<td>Aortic Arch</td>
<td>20 (21%)</td>
<td>38 (39%)</td>
<td>39 (40%) [30-51]</td>
</tr>
<tr>
<td>Ascending Aorta</td>
<td>61 (63%)</td>
<td>36 (37%)</td>
<td>0 [0-4]</td>
</tr>
</tbody>
</table>

Khoury Z Am J Cardiol 1997; 79: 23-27
Limitations: Spasm

- Kiemeneij et al: showed objectively that Verapamil, Nitroglycerine & Heparin reduced spasm by 16%
- Chen et al: Showed no additional benefit of Verapamil when added to NTG alone in preventing spasm
- Coppola et al: showed no additional benefit of adding Nitroprusside to NTG.
# Predictors of Spasm

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Spasm N = 44</th>
<th>No Spasm N = 335</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial artery diameter/Height index (mm/m) Median</td>
<td>1.330</td>
<td>1.430</td>
<td>0.005</td>
</tr>
<tr>
<td>Radial artery diameter/BSA index (cm/m²) Median</td>
<td>0.120</td>
<td>0.130</td>
<td>0.012</td>
</tr>
<tr>
<td>Sheath diameter/Radial diameter index</td>
<td>1.090</td>
<td>1.040</td>
<td>0.024</td>
</tr>
</tbody>
</table>
Expert’s opinion

- Long sheath or short sheath
- Coated or uncoated?
- Side holes or no side holes
- Short guide wire or long
- 0.025 or 0.035 size wire
- Issue and solutions
Normal radial anatomy
Focal spasm
After additional dose of cocktail
Diffuse spasm
Tortuosity with focal spasm
PTCA wire and 4 F catheter
Tortuosity with diffuse spasm
PTCA wire and 4 F catheter
Limitations – Related to Radial regions

- Spasm
- Hypoplasia: Congenial or acquired
- Atherosclerosis & Calcification
- Abnormal course of radial artery
  - Tortuosity with atherosclerosis or spasm
  - High origin Brachial artery/Axillary artery
  - Loops & Curvatures
Congenial hypoplasia (rudimentary radial)
Acquired Hypoplasia or Radial & Ulnar & Brachial in IVDA
Atherosclerosis & Calcification

Patel’s Atlas on Trans radial intervention – The basics

Cardiology department, SVCMC
Tortuosity
Complications

Patel’s Atlas on Trans radial intervention – The basics

Cardiology department, SVCMC
Complication

- Asymptomatic radial artery occlusion 3-4% reported in literature
- Forearm discomfort for 2 days (0.2%)
- Rare anecdotal report oferve injury leading to causalgia, AV fistula, Radial artery eversion during sheath removal.
- None reported limb loss.
TRI FEASIBILITY STUDIES (TRANSRADIAL INTERVENTION A SAFE ALTERNATE)
TRI:
COMPARE WITH TRANSFEMORAL INTERVENTION
COMPARE WITH ULNAR OR BRACHIAL
TRI:
TREATING STABLE CAD/ SAME DAY DISCHARGE.
IN ACUTE MYOCARDIAL INFARCTION AND WITH IIB/III.
TRI: HARDWARE
SHEATHS-HYDROPHILIC COATING
CATHETERS
OTHER HARDWARE USE.
TRI:
CEREBRAL
RENAL
PERIPHERAL (ILIAC)
TRI:
SPASMOLYTIC COCKTAIL & LOCAL CIRCULATION
ACCESS SITE COMPLICATION & LIMITATION OF REPEATED INTERVENTION.
RADIAL CLOSURE DEVICE.
TRI: LIMITATIONS
LOOPS, CURVES & VARIATIONS OF ANATOMY
COMPLICATION
RADIAL ARTERY GRAFT