TRANSRADIAL CARDIAC CATHETERIZATION

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Heart Care Centers of Florida

April 13, 2013
TOPICS

- Historical perspective and current trends
- Rationale for the radial approach
  - Bleeding complications
- Comparison of radial and femoral access
- Transradial STEMI program
- Some radial specific issues
- Educational resources and training
OBJECTIVES

- Understand transradial approach to cardiac catheterization
- Discuss risks and benefits of transradial approach
- Key goals for developing an aggressive transradial approach
- Identify education and resources for catheterization
Historical Perspective

- **1948**: First attempted transradial coronary angiogram using *radial cut-down*
  - 8-10 F catheters: too large for most radials
- **1989**: Campeau reported first 100 cases of *percutaneous* transradial coronary angiograms
- **1993**: First transradial coronary angioplasty with stent implantation performed
  - Performed using 6F guide catheter
Figure 1. Proportion of PCI Cases Performed Via the Radial Artery

Proportion of percutaneous coronary intervention (PCI) cases performed via the radial artery approach (r-PCI) across sites.

**Current Trends**

Figure 2. Trend in the Use of r-PCI Over Time in Key Subgroups

Trend in the use of the radial approach to percutaneous coronary intervention (r-PCI) over time in (A) the overall dataset; (B) patients age <75 and ≥75 years; (C) men and women; (D) patients with stable angina, non-ST-segment elevation acute coronary syndrome (NSTE ACS), and ST-segment elevation myocardial infarction (STEMI).

Rationale for use of TRA

Advantages:
- Reduced risk of major bleeding
- Improved patient comfort and convenience
- Immediate ambulation
- Reduced inpatient time and cost, faster turnover of beds
Bleeding Complications

Advances in antiplatelet and anticoagulant therapies in patients with ACS undergoing PCI have reduced ischemic events and improved overall outcomes.

Bleeding complications have remained relatively constant in cardiac cath/PCI.

Bleeding associated with increase risk of mortality, recurrent MI and stroke.
Meta-analysis of Bleeding in ACS

Table of studies:

<table>
<thead>
<tr>
<th>Study</th>
<th>Major bleeding</th>
<th>No major bleeding</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eikelboom et al 2006</td>
<td>60/470</td>
<td>833/33676</td>
<td>5.16 [4.04, 6.60]</td>
</tr>
<tr>
<td>Lenderink et al 2004</td>
<td>18/98</td>
<td>120/7702</td>
<td>11.79 [7.49, 18.55]</td>
</tr>
<tr>
<td>Manoukian et al 2007</td>
<td>47/644</td>
<td>159/13175</td>
<td>11.79 [7.49, 18.55]</td>
</tr>
<tr>
<td>Moscoucci et al 2003</td>
<td>85/546</td>
<td>624/15348</td>
<td>6.05 [4.41, 8.29]</td>
</tr>
<tr>
<td>Segev et al 2005</td>
<td>15/79</td>
<td>86/5763</td>
<td>8.96 [7.28, 11.02]</td>
</tr>
<tr>
<td>Yusuf et al 2006</td>
<td>83/629</td>
<td>545/19449</td>
<td>12.72 [7.71, 21.01]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>450/3644</td>
<td>3003/129953</td>
<td>4.71 [3.79, 5.85]</td>
</tr>
</tbody>
</table>

Test for heterogeneity: Chi ≤85.44, df=9 (P<0.00001), I²=89.5%
Test for overall effect: Z=12.65 (P<0.000001)

Figure 2. Pooled relative risks of mortality increase in patients with ACS and major bleeding: random-effects meta-analysis of 10 studies.

Hamon et al, EuroIntervention 2007; 3: 400-408
Major Femoral Bleeding Post-PCI

- Mayo clinic PCI database 1994-2005
- Changes in type, intensity and duration of anticoagulation protocols over time

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>2441</td>
<td>6207</td>
<td>9253</td>
</tr>
<tr>
<td>Sheath size (F)</td>
<td>8.2 ± 0.7</td>
<td>7.8 ± 0.9</td>
<td>6.4 ± 0.8</td>
</tr>
<tr>
<td>GP IIb/IIIa use</td>
<td>27 (1%)</td>
<td>2536 (41%)</td>
<td>5328 (58%)</td>
</tr>
<tr>
<td>Peak ACT</td>
<td>405 ± 110</td>
<td>339 ± 79</td>
<td>312 ± 61</td>
</tr>
<tr>
<td>Heparin post procedure</td>
<td>1995 (80%)</td>
<td>2215 (36%)</td>
<td>2456 (27%)</td>
</tr>
</tbody>
</table>

Doyle et al, JACC Interventions 2008; 1: 202-9
Major Femoral Bleeding Post-PCI

Figure 1. Changing Incidence of Major Femoral Bleeding Complications From 1994 to 2005

The incidence of major femoral bleeding declined significantly from the earliest (8.4%) to the contemporary time period (3.5%).

Doyle et al, JACC Interventions 2008; 1: 202-9
## OASIS-5: Fondaparinux

Comparison of Fondaparinux vs Enoxaparin in patients with ACS

<table>
<thead>
<tr>
<th>Time and Outcome</th>
<th>Enoxaparin (N=10,021)</th>
<th>Fondaparinux (N=10,057)</th>
<th>Hazard Ratio (95% CI)</th>
<th>P Value for Superiority</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 Days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death, MI, or refractory ischemia</td>
<td>573 (5.7)</td>
<td>579 (5.8)</td>
<td>1.01 (0.90–1.13)</td>
<td>NA</td>
</tr>
<tr>
<td>Death or MI†</td>
<td>412 (4.1)</td>
<td>409 (4.1)</td>
<td>0.99 (0.86–1.13)</td>
<td>NA</td>
</tr>
<tr>
<td>Death</td>
<td>186 (1.9)</td>
<td>177 (1.8)</td>
<td>0.95 (0.77–1.17)</td>
<td>NA</td>
</tr>
<tr>
<td>MI</td>
<td>264 (2.7)</td>
<td>263 (2.6)</td>
<td>0.99 (0.84–1.18)</td>
<td>NA</td>
</tr>
<tr>
<td>Refractory ischemia</td>
<td>188 (1.9)</td>
<td>194 (1.9)</td>
<td>1.03 (0.84–1.26)</td>
<td>NA</td>
</tr>
<tr>
<td>Stroke</td>
<td>45 (0.5)</td>
<td>37 (0.4)</td>
<td>0.82 (0.53–1.27)</td>
<td>NA</td>
</tr>
<tr>
<td>Major bleeding</td>
<td>412 (4.1)</td>
<td>217 (2.2)</td>
<td>0.52 (0.44–0.61)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Death, MI, refractory ischemia, or major bleeding</td>
<td>905 (9.0)</td>
<td>737 (7.3)</td>
<td>0.81 (0.73–0.89)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Death, MI, or stroke</td>
<td>446 (4.5)</td>
<td>435 (4.3)</td>
<td>0.97 (0.85–1.11)</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Yusuf et al, NEJM 2006; 354: 1464-1476
Regardless of Treatment Arm, those who suffered a major bleeding event had worse outcomes at 30 days:

- Increased risk of death (13.2% vs 2.8%)
- Increased risk of MI (11.9% vs 3.6%)
- Increased risk of stroke (3.5% vs 0.7%)

Yusuf et al, NEJM 2006; 354: 1464-1476
Choice of Access Site in ACUITY

- Femoral site chosen in 93.8%
- Radial site chosen in 6.2%

Subgroup analysis with some important differences in baseline characteristics:

- Femoral approach more commonly used in:
  - Older patients
  - Females
  - Established CAD
  - Enrolled in the US

Hamon, EuroIntervention 2009; 1: 115-20
Choice of Access Site in ACUITY

No difference in composite outcome of death / MI / ischemia at 30 days or at 1 year

Bleeding:

<table>
<thead>
<tr>
<th></th>
<th>Radial</th>
<th>Femoral</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access site bleeding</td>
<td>0.9%</td>
<td>2.1%</td>
<td>0.009</td>
</tr>
<tr>
<td>TIMI non-CABG major bleeding</td>
<td>1.0%</td>
<td>1.5%</td>
<td>0.37</td>
</tr>
<tr>
<td>Non-CABG major bleeding</td>
<td>3.0%</td>
<td>4.8%</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Hamon, EuroIntervention 2009; 1: 115-20
MORTAL Study

British Columbia Cardiac Registry (similar to NCDR) used to evaluate patients who had undergone PCI from 1999-2005

Cross-referenced with Central Transfusion Registry to identify patients transfused within 10 days of PCI

Objective:

- To determine association of arterial access site (radial vs femoral) with transfusion and mortality

Chase et al, Heart 2008; 94: 1019-1025
## MORTAL Study

### Baseline characteristics: multiple variables with statistically significant differences

<table>
<thead>
<tr>
<th>Variable</th>
<th>Radial N = 7,972</th>
<th>Femoral N = 30,900</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective</td>
<td>32.4%</td>
<td>26.3%</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Urgent</td>
<td>55.3%</td>
<td>62.4%</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Dialysis</td>
<td>0.7%</td>
<td>1.8%</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Prior MI</td>
<td>25.5%</td>
<td>34.1%</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Prior CABG</td>
<td>6.9%</td>
<td>13.5%</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td><strong>Liver/GI comorbidities</strong></td>
<td>2.4%</td>
<td>6.9%</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td><strong>Malignancy</strong></td>
<td>2.3%</td>
<td>7.2%</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>
MORTAL Study - Transfusion

Odds Ratios (adjusted for baseline characteristics) for mortality related to receiving transfusion vs no transfusion:

- 30 day: 4.01 (95% CI 3.08 to 5.22)
- 1 year: 3.58 (95% CI 2.94 to 4.36)

Propensity Score Matching confirmed higher risk of 30d and 1 year mortality if transfused.

Chase et al, Heart 2008; 94: 1019-1025
MORTAL Study - Access Site

- Odds Ratios (adjusted for baseline characteristics) for receiving a transfusion based on Radial vs Femoral access:
  - 0.59 (95% CI 0.48 to 0.73), p < 0.001

- Adjusted OR for mortality: TRA v TFA
  - 30 day: 0.71 (95% CI 0.61 to 0.82) p < 0.001
  - 1 year: 0.83 (95% CI 0.71 to 0.98) P < 0.001

- If only non-transfused procedures analyzed, difference in mortality non-significant
  - Supports hypothesis that mortality difference closely linked with need for transfusion

Chase et al, Heart 2008; 94: 1019-1025
# Mortality & Bleeding / Transfusion

## Table 1

<table>
<thead>
<tr>
<th>Author/Study (Ref. #)</th>
<th>Patients (n)</th>
<th>Patient Population</th>
<th>STEMI Included?</th>
<th>Definition</th>
<th>Frequency of Blood Transfusion (%)</th>
<th>Impact of Bleeding on Mortality [95% Confidence Interval]</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinnaird et al. (1)</td>
<td>10,974</td>
<td>Unselected</td>
<td>Yes</td>
<td>TIMI</td>
<td>5.4</td>
<td>30-day adjusted OR: 3.5 [1.9–6.7]</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>REPLACE-2 (2)</td>
<td>6,001</td>
<td>Elective and ‘urgent’ PCI</td>
<td>No</td>
<td>Protocol†</td>
<td>3.2</td>
<td>1-year adjusted OR: 2.66 [1.44–4.92]</td>
<td>0.002</td>
</tr>
<tr>
<td>Ndrepea et al. (3)</td>
<td>5,348</td>
<td>Elective, ACS</td>
<td>No</td>
<td>TIMI</td>
<td>4.0</td>
<td>1-year adjusted HR: 2.96 [1.96–4.48]</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>ACUITY (4)</td>
<td>13,819</td>
<td>ACS only</td>
<td>No</td>
<td>Protocol†</td>
<td>4.7</td>
<td>30-day OR: 7.55 [4.68–12.18]</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Kim et al. (5)</td>
<td>6,799</td>
<td>Unselected</td>
<td>Yes</td>
<td>Protocol†</td>
<td>8.0</td>
<td>1-year RR: 2.03 (transfused patients)</td>
<td>0.0028</td>
</tr>
<tr>
<td>Doyle et al. (6)</td>
<td>17,901</td>
<td>Unselected</td>
<td>Yes</td>
<td>Protocol†</td>
<td>4.8</td>
<td>30-day adjusted HR: 9.98 [6.94–14.3]</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>GRACE registry (7)*</td>
<td>24,045</td>
<td>ACS</td>
<td>Yes</td>
<td>Protocol†</td>
<td>3.9</td>
<td>In-hospital adjusted OR: 1.64 [1.18–2.26]</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Yatskar et al. (8)</td>
<td>6,656</td>
<td>Unselected</td>
<td>Yes</td>
<td>Protocol†</td>
<td>1.8</td>
<td>In-hospital adjusted OR: 3.59 [1.66–7.77]</td>
<td>0.001</td>
</tr>
</tbody>
</table>

## Table 2

<table>
<thead>
<tr>
<th>Author (Ref. #)</th>
<th>Patients (n)</th>
<th>Patient Population</th>
<th>STEMI Included?</th>
<th>Frequency of Blood Transfusion (%)</th>
<th>Impact of Transfusion on Mortality [95% Confidence Interval]</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jani et al. (12)</td>
<td>4,623</td>
<td>Anemic patients with MI</td>
<td>Yes</td>
<td>22.3</td>
<td>In-hospital, adjusted OR: 2.02 [1.47–2.79]</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Doyle et al. (6)</td>
<td>17,901</td>
<td>Unselected</td>
<td>Yes</td>
<td>6.8</td>
<td>30 days, 1–2 U adjusted HR: 8.9 [6.3–12.6]</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3+ U adjusted HR: 18.1 [13.7–24]</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Kinnaird et al. (1)</td>
<td>10,974</td>
<td>Unselected</td>
<td>Yes</td>
<td>5.4</td>
<td>1 year, OR per unit transfused: 1.47 [1.36–1.55]</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Kim et al. (5)*</td>
<td>567*</td>
<td>Severe bleeding</td>
<td>Yes</td>
<td>25.7</td>
<td>1 year, RR: 2.03</td>
<td>0.0028</td>
</tr>
<tr>
<td>Chase et al. (13)</td>
<td>38,872</td>
<td>Unselected</td>
<td>Yes</td>
<td>3.5</td>
<td>30-day adjusted OR: 4.01 [3.08–5.22]</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1-year adjusted OR: 3.58 [2.94–4.36]</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

RIVIERA Study

Multinational prospective observation study to determine predictors of adverse outcomes following PCI

7962 patients from 23 countries

Both elective (92%) and primary PCI (8%)

Radial approach: 841 pts (10.6%)

Femoral approach: 7062 pts (89.2%)

RIVIERA Study: Death / MI

Fig. 1. Independent predictors of death or myocardial infarction. *Reference is asymptomatic or unstable angina. CI, confidence interval; GP; glycoprotein; LADCA, left anterior descending coronary artery; NSTE-ACS, non-ST-segment elevation acute coronary syndrome; OR, odds ratio; PCI, percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction; UFH, unfractionated heparin.

Montelescot et al, Int J Card 2008; 129(3):
RIVIERA Study: Bleeding

Fig. 2. Independent predictors of bleeding. ACE, angiotensin-converting enzyme; ARA, adenosine receptor antagonist; CI, confidence interval; GP, glycoprotein; IMAG+SG, internal mammary artery graft or saphenous graft; OR, odds ratio; UFH, unfractionated heparin.
Mechanisms for Increased Mortality

Figure 1  Possible Mechanisms Linking Post-Percutaneous Coronary Intervention Bleeding With Increased Mortality

Figure provided by the Mayo Clinic ©2008.
Why all this talk about bleeding?

Bleeding complications are a big deal

Needing a transfusion after cath is a marker of high risk - strongly (perhaps even causally) related to adverse events

Efforts to further reduce risk of bleeding and reduce the chance of needing a transfusion are of utmost importance
Meta-analysis Radial vs Femoral

12 RCTs included spanning 1994-2003 evaluating Coronary Angiography and/or PCI from TR vs TF approach

Total of 3224 pts
- 1668 Transradial
- 1556 Transfemoral

7 studies - Diagnostic only
5 studies - PCI: of these 2 in ACS/AMI

Agostoni et al, JACC 2004; 44: 349-56
# Meta-analysis - MACE

<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>Grinfeld</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, 7.04]</td>
<td>1999</td>
</tr>
<tr>
<td>Monséguy</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>Gorge</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>8/183</td>
<td>0.60 [0.19, 1.86]</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>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td>1668</td>
<td>1556</td>
<td>0.92 [0.57, 1.48]</td>
<td></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)

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Agostoni et al, JACC 2004; 44: 349-56
Meta-analysis - Entry Site Complications

<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>Grinfeld</td>
<td>0/138</td>
<td>3/141</td>
<td>0.14 [0.01, 2.79]</td>
<td>1996</td>
</tr>
<tr>
<td>Mann 1996</td>
<td>0/76</td>
<td>4/76</td>
<td>0.11 [0.01, 1.99]</td>
<td>1996</td>
</tr>
<tr>
<td>ACCESS</td>
<td>0/300</td>
<td>6/300</td>
<td>0.08 [0.00, 1.34]</td>
<td>1997</td>
</tr>
<tr>
<td>BRAFE Stent</td>
<td>1/56</td>
<td>3/56</td>
<td>0.32 [0.03, 3.19]</td>
<td>1997</td>
</tr>
<tr>
<td>Mann 1998</td>
<td>0/74</td>
<td>3/68</td>
<td>0.13 [0.01, 2.48]</td>
<td>1998</td>
</tr>
<tr>
<td>Cooper</td>
<td>0/101</td>
<td>0/99</td>
<td>Not estimable</td>
<td>1999</td>
</tr>
<tr>
<td>CARAFE</td>
<td>0/140</td>
<td>2/70</td>
<td>0.10 [0.00, 2.06]</td>
<td>2001</td>
</tr>
<tr>
<td>Gorge</td>
<td>1/214</td>
<td>1/216</td>
<td>1.01 [0.06, 16.24]</td>
<td>2001</td>
</tr>
<tr>
<td>Moriyama</td>
<td>0/108</td>
<td>3/92</td>
<td>0.12 [0.01, 2.31]</td>
<td>2002</td>
</tr>
<tr>
<td>OCTOPLUS</td>
<td>3/188</td>
<td>12/183</td>
<td>0.23 [0.06, 0.83]</td>
<td>2003</td>
</tr>
<tr>
<td>TEMPURA</td>
<td>0/77</td>
<td>2/72</td>
<td>0.18 [0.01, 3.85]</td>
<td>2003</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>1472</td>
<td>1373</td>
<td>0.20 [0.09, 0.42]</td>
<td></td>
</tr>
</tbody>
</table>

Total events: 5 (Radial), 39 (Femoral)
Test for heterogeneity: \(\chi^2 = 2.66, df = 9 (P = 0.98)\)
Test for overall effect: \(Z = 4.20 (P < 0.0001)\)

Agostoni et al, JACC 2004; 44: 349-56
# Meta-analysis - Procedural Failure

<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>OR (random) 95% CI</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mann 1996</td>
<td>7/76</td>
<td>3/76</td>
<td>2.47 [0.61, 9.93]</td>
<td></td>
<td>1996</td>
</tr>
<tr>
<td>ACCESS</td>
<td>21/300</td>
<td>1/300</td>
<td>22.51 [3.01, 168.42]</td>
<td></td>
<td>1997</td>
</tr>
<tr>
<td>BRAFE Stent</td>
<td>6/56</td>
<td>1/56</td>
<td>6.60 [0.77, 56.74]</td>
<td></td>
<td>1997</td>
</tr>
<tr>
<td>Cooper</td>
<td>2/101</td>
<td>1/99</td>
<td>1.98 [0.18, 22.19]</td>
<td></td>
<td>1999</td>
</tr>
<tr>
<td>CARAFE</td>
<td>1/140</td>
<td>0/70</td>
<td>1.52 [0.06, 37.70]</td>
<td></td>
<td>2001</td>
</tr>
<tr>
<td>Gorge</td>
<td>1/214</td>
<td>0/216</td>
<td>3.04 [0.12, 75.09]</td>
<td></td>
<td>2001</td>
</tr>
<tr>
<td>Moriyama</td>
<td>8/108</td>
<td>2/92</td>
<td>3.60 [0.74, 17.40]</td>
<td></td>
<td>2002</td>
</tr>
<tr>
<td>OCTOPLUS</td>
<td>20/188</td>
<td>17/183</td>
<td>1.16 [0.59, 2.30]</td>
<td></td>
<td>2003</td>
</tr>
<tr>
<td>TEMPURA</td>
<td>0/77</td>
<td>1/72</td>
<td>0.31 [0.01, 7.67]</td>
<td>3.30 [1.63, 6.71]</td>
<td>2003</td>
</tr>
</tbody>
</table>

Total (95% CI): 1472 / 1373

Total events: 107 (Radial), 33 (Femoral)

Test for heterogeneity: Chi² = 18.71, df = 10 (P = 0.04)

Test for overall effect: Z = 3.31 (P = 0.0009)

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Agostoni et al, JACC 2004; 44: 349-56
Meta-analysis: Secondary Endpoints

Significant heterogeneity

- Fluoroscopy time shorter for Femoral
  - TFA - 7.8 min vs TRA - 8.9 min
    - (Diff: 1.05, 95% CI diff: 0.51 to 1.60, p < 0.001)

- Mean hospital stay shorter for Radial
  - TFA - 2.4 days vs TRA - 1.8 days
    - (Diff: 0.55, 95% CI diff: 0.29 to 0.82, p < 0.001)

- Total hospital charge lower for Radial
  Agostoni et al, JACC 2004; 44: 349-56
Meta-analysis 2: - Radial vs Femoral

- 23 studies included spanning 1993 - 2007

- Major Bleeding:
  - Radial: 0.5% (13 / 2390 pts)
  - Femoral: 2.3% (48 / 2068 pts)
    \[ \text{OR: 0.27 (95\% CI 0.16 - 0.45, p < 0.001)} \]

- Trend towards reduced composite of death / MI / stroke
  \[ \text{OR: 0.71 (95\% CI 0.49 - 1.01, p = 0.058)} \]

- Trend towards reduced mortality
  \[ \text{OR 0.74 (95\% CI 0.42 - 1.30, p = 0.29)} \]

Radial PCI in STEMI

Single center longitudinal cohort study

530 patients with STEMI undergoing primary PCI < 12hrs enrolled in registry

Access: chosen at discretion of operator

Default access = Radial, with Femoral access used if unfavorable Allen test or h/o CABG

Baseline characteristics:

- Radial group more likely to be older, male, higher BMI, less likely to have prior MI

Radial PCI in STEMI - MACE

Figure 1. MACE at 1 year of follow-up. Chart labels represent percentages of each event. Data in axis represent absolute value of each event.

Azmendi et al, Am J Card 2010; 106(2): 148-
Transradial disadvantages

- Longer procedure time
- Increased door to balloon time in STEMI pts
- Radial artery occlusion/lack of conduit
- Increased radiation exposure for patient/staff/physicians
From brachial to Transfemoral approach

- Dominant strategy since Dr Melvin Judkins
- Large vessels
- Preformed catheters
- Avoided cutdowns (Brachial artery Sones)
- Could tolerate larger catheter size
- Could be repeated
- Percutaneous
- Anatomy straightforward
Transfemoral potential pitfalls

- Entry site critical
- Landmarks sometimes very problematic
- The Red Sea
- Space for unrecognized blood collections
- Hemostasis
- Peripheral arterial disease
Door-to-Balloon time

Single-center observational study 2005-9

4 PCI operators
- 1 preferred TF, 1 preferred TR, 2 no preference - all trained in both

240 consecutive STEMI cases

205 undergoing successful PCI
- 124 trans-radial
- 116 trans-femoral

Weaver et al, CCI 2010; 75: 695-699
Door-to-Balloon time

<table>
<thead>
<tr>
<th></th>
<th>Radial (n = 124)</th>
<th>Femoral (n = 116)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door to ECG (min)</td>
<td>9.1 ± 9.3</td>
<td>9.9 ± 10.3</td>
<td>0.55</td>
</tr>
<tr>
<td>ECG to HA (min)</td>
<td>5.5 ± 6.7</td>
<td>7.9 ± 11.5</td>
<td>0.05</td>
</tr>
<tr>
<td>HA activation to team arrival (min)</td>
<td>22.5 ± 11.9</td>
<td>23.1 ± 10.1</td>
<td>0.68</td>
</tr>
<tr>
<td>Team arrival to patient arrival in lab (min)</td>
<td>11.6 ± 6.6</td>
<td>13.3 ± 7.5</td>
<td>0.07</td>
</tr>
<tr>
<td>Arrival in cath lab to balloon inflation (min)</td>
<td>28.4 ± 11.3</td>
<td>32.7 ± 12.4</td>
<td>0.01</td>
</tr>
<tr>
<td>Case start to access time (min)</td>
<td>12.5 ± 5.4</td>
<td>10.5 ± 5.7</td>
<td>0.005</td>
</tr>
<tr>
<td>Time from access to balloon inflation (min)</td>
<td>18.3 ± 10.8</td>
<td>24.1 ± 11.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Door to balloon time (min)</td>
<td>76.4 ± 26.4</td>
<td>86.5 ± 27.6</td>
<td>0.008</td>
</tr>
<tr>
<td>Number of total coronary catheters used (min)</td>
<td>2.9 ± 1.0</td>
<td>3.1 ± 0.8</td>
<td>0.02</td>
</tr>
<tr>
<td>Fluoroscopy time (min)</td>
<td>12.5 ± 7.9</td>
<td>15.2 ± 10.1</td>
<td>0.02</td>
</tr>
<tr>
<td>Contrast given (mL)</td>
<td>168.5 ± 66.6</td>
<td>186.7 ± 68.2</td>
<td>0.04</td>
</tr>
</tbody>
</table>

ECG = electrocardiogram, HA = heart alert.

Weaver et al, CCI 2010; 75: 695-699
Radiation Exposure

- Study performed in Germany where one experienced operator (>1500 radial cases) performed coronary angiography ± PCI
- Pts randomized to TR or TF approach
- Radiation dosimeter used to measure operator exposure in µSv
- Patient radiation dose measured in terms of dose-area product (Gy.cm²) and fluoroscopy time

Lange et al, CCI 2006; 67: 12-16
Radiation Exposure

Potential for increased radiation exposure both to patient and operator

Close attention to techniques and precautions for minimizing exposure needed

Lange et al, CCI 2006; 67: 12-16
Radial Artery Occlusion

- Incidence post TRA:
  - 5% based on clinical diagnosis
  - 9% based on ultrasonography

- Risk of RAO independently associated with
  - sheath/artery ratio > 1
  - Lack of peri-procedural anticoagulation

- Hand ischemia rare, but RAO has implications for:
  - access for subsequent coronary angiography
  - future use of radial artery as graft for CABG or fistula for HD
Patent Hemostasis Reduces RAO

- **PROPHET:** 436 patients randomized to:
  - **Conventional Hemostasis**
    - Hemoband applied with immediate sheath removal
    - Band removed after 2 hrs
    - Radial patency was checked using Barbeau’s test but pressure not adjusted (43% were occlusive)
  - **Patent Hemostasis**
    - Pulse oximeter sensor applied to index finger
    - Ulnar artery occluded with manual pressure
    - Hemoband applied as above, loosened until signal returned → confirms radial patent
    - Band removed after 2 hrs as above

Pancholy et al, CCI 2008; 2: 335-340
Learning Curve

Trans-radial approach perceived as more difficult to learn than trans-femoral

- Small sized vessel
- Prone to spasm
- Higher percentage of anatomic variation
- Can be difficult to transverse the subclavian and aortic arch
Early studies report failure rates of:

- First 50 cases: around 10%
- First 500 cases: 3-4%
- After 1000 cases: approx 1%

Spaulding et al, Cath Cardiovasc Diagnosis 1996; 39: 365-370
Catheters

Featuring Terumo’s Exclusive Tiger and Jacky Shapes

- Enables angiography of both RCA and LCA with one catheter
- Eliminates catheter exchange step
- Shortens procedure and fluoroscopic time

- Engages with simple clockwise and counterclockwise rotation
  - Enhances ease of use

- Two unique shapes specially designed for right transradial approach
  - Tiger shape, with straight distal soft tip
  - Jacky shape, with outward distal soft tip

- Tiger and Jacky shapes are available in two sizes for various anatomy
Optitorque™

A complete line of coronary diagnostic catheters with optimum torque control and precise placement for an ideal catheterization procedure.

- Double-braided stainless steel (two-ply) mesh middle layer
  - Superior (1:1) torque control
  - Precise manipulation

- Large lumen
  - High flow of contrast media
  - Allows downsizing of French size without reducing performance quality

- Soft tip
  - Atraumatic to coronary ostium
  - Reduces potential for vessel trauma
Transradial benefits

Reduces the risk of bleeding complications, swelling and back pain, especially in women, obese patients, elderly patients and those with peripheral vascular disease (PVD)

Has better first-time success rates for accessing arteries in obese patients and patients with PVD

Improves patient outcomes and overall experiences

Enables patients to be mobile almost immediately after the procedure

Shortens hospital stays

Causes less pain after the procedure

Reduces procedure costs

Improves patient satisfaction
Summary

Trans-radial PCI is a safe and effective alternative to the trans-femoral approach, both for elective and emergent cases.

Associated with reduction in bleeding complications and need for transfusion.

High success rates after initial learning curve period.
REFERENCES


