MHIF Research Highlights: November 2020

AHA 2020 – Online Starting Nov. 13!

MHIF Research will be highlighted in:
• 3 late-breaking presentations
• 1 oral presentation
• 3 moderated digital presentations
• 15 poster presentations

Thanks to our MHI physician partners who are helping us complete tasks to get patients enrolled in research studies as appropriate during COVID-19!

We appreciate our partnership with you!

Abstract Oral Session
• Dr. Traverse - Cardiosphere-derived Cells Improve Segmental Myocardial Circumferential Strain by Magnetic Resonance Imaging: Results from the Allogeneic Heart Stem Cells to Achieve Myocardial Regeneration

Late-breaking Science
• Dr. Lin - RHAPSODY: Rilonacept an IL-1α and IL-1β Trap Resolves Pericarditis Episodes and Reduces Risk of Recurrence in a Phase 3 Trial of Patients With Recurrent Pericarditis
• Dr. Bradley - The AHA COVID-19 Cardiovascular Disease Registry: Design, Implementation, and Initial Results
• Dr. Bradley - Racial and Ethnic Differences in Treatment and Outcomes for Patients Hospitalized with COVID-19: Findings from the American Heart Association COVID-19 Cardiovascular Disease Registry

MHIF FEATURED STUDIES:

COVID PACT
Comparing anticoagulation therapy in COVID+ patients in the ICU
PI: Dr. Brandon Wiley
CONTACT:
Christine Majeski - Christine.majeski@allina.com

cvMOBIUS Registry
Evaluating PCSK9 inhibitors among subjects with a recent ASCVD event
PI: Dr. Courtney Baechler
CONTACT:
Andie Sarafolean - Andie.Sarafolean@allina.com
MHIF FEATURED STUDY: ARIES

<table>
<thead>
<tr>
<th>CONDITION:</th>
<th>Heart Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI:</td>
<td>Peter Eckman, MD</td>
</tr>
<tr>
<td>RESEARCH CONTACT:</td>
<td>Kari Thomas &amp; Sarah Schwager</td>
</tr>
<tr>
<td></td>
<td><a href="mailto:Kari.m.thomas@allina.com">Kari.m.thomas@allina.com</a> 612-863-7493</td>
</tr>
<tr>
<td></td>
<td><a href="mailto:Sarah.Schwager@allian.com">Sarah.Schwager@allian.com</a> 612-863-6257</td>
</tr>
<tr>
<td>SPONSOR:</td>
<td>Abbott Vascular</td>
</tr>
</tbody>
</table>

DESCRIPTION:
The purpose of this study is to understand if aspirin is needed in subjects implanted with HeartMate 3. Subjects with devices like HeartMate 3 take two blood thinner medicines, specifically warfarin and aspirin. Subjects often experience both clotting and bleeding complications.

Data suggests that the HeartMate 3 may not require as much anticoagulation as are used with similar devices. This study will test if subjects need aspirin together with warfarin or just warfarin alone.

CRITERIA LIST/ QUALIFICATIONS:
**Inclusion:**
- Subjects will receive the HeartMate 3 as their first LVAD

**Exclusion:**
- Post implant additional temporary or permanent mechanical circulatory support (MCS)
- Investigator mandated antiplatelet therapy for other conditions
MHIF FEATURED STUDY:

cvMOBIUS Registry

DESCRIPTION:
The purpose of cvMOBIUS (Cardiovascular Multi-dimensional Observational Investigation of the Use of PCSK9 Inhibitors) is to evaluate the effectiveness of PCSK9 inhibitors to reduce cardiovascular events among subjects with a recent ASCVD event or revascularization procedure.

While large randomized trials have shown additional lipid-lowering through PCSK9i can further reduce risk of ASCVD events, real-world effectiveness of PCSK9i in subjects with ASCVD events has yet to be established.

CRITERIA LIST/ QUALIFICATIONS:

Inclusion:

• ≥ 40 y.o.
• Hospitalization for a clinical ASCVD event (acute MI, unstable angina, IS or CLI) within 18 months of enrollment and/or coronary, peripheral, or carotid revascularization including percutaneous or surgical revascularization in the past 18 months
• LDL ≥ 70 mg/dL with no immediate plans for statin change or newly started on PCSK9i after index hospitalization/procedure (no more than 6 months prior to enrollment)

Exclusion: ESRD, on a PCSK9i prior to qualifying event
MHIF FEATURED STUDY: COVID PACT

DESCRIPTION:
The purpose of this trial is comparing antiplatelet and anticoagulation strategies in critically ill COVID19 patients. Patients will be randomized to 1:1 to these treatment arms and then further randomized into anti-platelet vs no antiplatelet treatments and followed for thrombotic complications.

CRITERIA LIST/QUALIFICATIONS:

**Inclusion:**
- 18 or older
- Acute infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV2)
- Currently admitted to an intensive care unit (ICU)

**Exclusion:**
- Ongoing (>48 hours) or planned full-dose (therapeutic) anticoagulation for any indication
- Ongoing or planned treatment with dual antiplatelet therapy
- Contraindication to antithrombotic therapy or high risk of bleeding
- History of heparin-induced thrombocytopenia
- Ischemic stroke within the past 2 weeks
Contemporary In-Hospital Outcomes of Chronic Total Occlusion Interventions: Update from the PROGRESS-CTO Multicenter International Registry

Judit Karacsonyi, MD, PhD¹ ²
on the behalf of the PROGRESS CTO investigators

¹Minneapolis Heart Institute and Minneapolis Heart Institute Foundation, Abbott Northwestern Hospital, Minneapolis, MN, USA
²Division of Invasive Cardiology, Second Department of Internal Medicine and Cardiology Center, University of Szeged, Szeged, Hungary

Coauthors:

Khaldoon Alaswad, MD
Dimitri Karmpailiotis, MD, PhD
Oleg Krestyaninov, MD
James W. Choi, MD
Jaikirshan J. Khatri, MD
Farouc A. Jaffer, MD, PhD
Mitul Patel, MD
Ehtisham Mahmud, MD
Anthony H. Doing MD
Philip Dattilo, MD
David E. Kandzari, MD
Michalis Koutouzis, MD
Ioannis Tsiapfoulis, MD
Barry Uretsky, MD
Catalin Toma, MD
Robert W. Yeh, MD
Hector Tamez, MD
R. Michael Wyman, MD
Brian K. Jefferson, MD
Taral Patel, MD
Wissam Jaber, MD
Habib Samady, MD
Abdul M. Sheikh, MD
Bilal A. Malik, MD
Srinivasa Potluri, MD
Basem Elbarouni, MD
Michael P. Love, MD
Alpesh R. Shah, MD
Jeffrey W. Moses, MD
Nicholas J. Lembo, MD
Manish Parikh, MD
Ajay J. Kirtane, MD
Ziad A. Ali, MD
Evangelia Vemmou, MD
Ilias Nikolakopoulos, MD
Iosif Xenogianenis, MD
Bavana V. Rangan, BDS, MPH
Santiago Garcia, MD
Subhash Banerjee, MD
Imre Ungi, MD, PhD
Emmanouil S. Brilakis, MD, PhD
I, Judit Karacsonyi DO NOT have a financial interest/arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation.

**Disclosure Statement of Financial Interest**

### CTO PCI: success and complications

<table>
<thead>
<tr>
<th>First Author</th>
<th>Study Period</th>
<th>Centers</th>
<th>Cases</th>
<th>Technical Success</th>
<th>Procedural Success</th>
<th>Overall MACE</th>
<th>Death</th>
<th>Acute MI</th>
<th>Stroke</th>
<th>TVR</th>
<th>Tamponade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Konstantinidis EURO-CTO registry</td>
<td>2008-2015</td>
<td>53</td>
<td>17,626</td>
<td>85%</td>
<td>—</td>
<td>0.6%</td>
<td>0.2%</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.4%</td>
</tr>
<tr>
<td>Habara Japanese Retrograde Summit Registry</td>
<td>2012-2013</td>
<td>56</td>
<td>3,229</td>
<td>—</td>
<td>88%</td>
<td>0.5%</td>
<td>0.2%</td>
<td>0.1%</td>
<td>0.1%</td>
<td>—</td>
<td>0.3%</td>
</tr>
<tr>
<td>Tajti PROGRESS-CTO</td>
<td>2012-2017</td>
<td>20</td>
<td>3,055</td>
<td>87%</td>
<td>85%</td>
<td>3.0%</td>
<td>0.3%</td>
<td>0.7%</td>
<td>0.1%</td>
<td>0.2%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Wilson UK Hybrid</td>
<td>2012-2014</td>
<td>7</td>
<td>1,156</td>
<td>90%</td>
<td>—</td>
<td>1.6%</td>
<td>0.0%</td>
<td>0.8%</td>
<td>0.4%</td>
<td>0.0%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Maeremans RECHARGE</td>
<td>2014-2015</td>
<td>17</td>
<td>1,253</td>
<td>89%</td>
<td>86%</td>
<td>2.6%</td>
<td>0.2%</td>
<td>0.2%</td>
<td>2.2%</td>
<td>0.1%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Sapontis OPEN CTO</td>
<td>2013-2017</td>
<td>12</td>
<td>1,000</td>
<td>86%</td>
<td>85%</td>
<td>7.0%</td>
<td>0.9%</td>
<td>2.6%</td>
<td>0.0%</td>
<td>0.1%</td>
<td>—</td>
</tr>
</tbody>
</table>
• DESIGN: Prospective, multi-center registry

PROGRESS CTO: ‘Prospective Global Registry for the Study of Chronic Total Occlusion Intervention’

• OBJECTIVE: to examine contemporary outcomes of CTO PCI by analyzing the clinical, angiographic and procedural characteristics of 7,031 CTO interventions performed in 6,984 patients at 35 participating centers between 2012 and 2020.

Global Coordinating Center: Chairman/PI: E. S. Brilakis; Global Director: B.V. Rangan; Database Managers: Ilias Nikolakopoulos, Evangelia Vemmou, Judit Karacsonyi

Project Impact: Data from 50 participating centers, Resulting in 61 publications, 90 conference presentations

International sites:
- Meskelin-Novosibirsk Research Institute, Russian Republic
- Kogiaslevo-Berakino Helenic Red Cross, Greece
- St. Boniface General Hospital, Canada
- St. George Hospital University Medical Center, Lebanon
- Areej Heart Centre, Maadi Yacoub Foundation, Egypt
- Marmara University School of Medicine Pendik Training and Research Hospital, Turkey
- Onduzuk Mayla University, Samsun, Turkey
- Kocaeli Acibadem Hospital, Izmit, Turkey
- Saksick University, Konya, Turkey
- Khartoum University, Sudan
- National Stroke Center, Malaysia

Funding: Abbott Northwestern Hospital Foundation
Joseph F. and Mary M. Fleischacker Foundation
www.progresscto.org
**Statistical analyses**

Categorical variables were expressed as percentages and were compared using Pearson’s chi-square test or the Fisher exact test. Continuous variables are presented as mean ± SD or as median (interquartile range [IQR]) and were compared using the Student’s t-test and the Wilcoxon rank sum test and as appropriate.

All statistical analyses were performed using JMP version 13.0 (SAS Institute, Cary, North Carolina).

A 2-sided p value of 0.05 was considered to indicate statistical significance.
## Results: Baseline clinical characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall (n=6984)</th>
<th>Technical success (n=6001)</th>
<th>Technical failure (n=983)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years) a</td>
<td>64.5 ± 10</td>
<td>64.3 ± 10</td>
<td>65.9 ± 9</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Men</td>
<td>82%</td>
<td>81%</td>
<td>87%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²) b</td>
<td>30.5 ± 6</td>
<td>30.4 ± 6</td>
<td>30.9 ± 6</td>
<td>0.068</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>42%</td>
<td>42%</td>
<td>43%</td>
<td>0.536</td>
</tr>
<tr>
<td>Hypertension</td>
<td>90%</td>
<td>90%</td>
<td>95%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>89%</td>
<td>89%</td>
<td>88%</td>
<td>0.266</td>
</tr>
<tr>
<td>Smoking (current)</td>
<td>23%</td>
<td>23%</td>
<td>23%</td>
<td>0.929</td>
</tr>
<tr>
<td>LVEF (%) a</td>
<td>50.1 ± 13</td>
<td>50.2 ± 13</td>
<td>50.0 ± 13</td>
<td>0.733</td>
</tr>
<tr>
<td>Family History of CAD</td>
<td>32%</td>
<td>32%</td>
<td>32%</td>
<td>0.969</td>
</tr>
<tr>
<td>Congestive Heart Failure</td>
<td>29%</td>
<td>29%</td>
<td>31%</td>
<td>0.226</td>
</tr>
<tr>
<td>Prior MI</td>
<td>45%</td>
<td>44%</td>
<td>49%</td>
<td>0.008</td>
</tr>
<tr>
<td>Prior CABG</td>
<td>29%</td>
<td>28%</td>
<td>37%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Prior cerebrovascular disease</td>
<td>10%</td>
<td>10%</td>
<td>11%</td>
<td>0.189</td>
</tr>
<tr>
<td>Prior peripheral vascular disease</td>
<td>14%</td>
<td>14%</td>
<td>17%</td>
<td>0.005</td>
</tr>
</tbody>
</table>

### Angiographic characteristics II.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall (n=7031)</th>
<th>Technical success (n=6040)</th>
<th>Technical failure (n=991)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTO Target Vessel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Right Coronary Artery</td>
<td>53%</td>
<td>52%</td>
<td>56%</td>
<td></td>
</tr>
<tr>
<td>• Left Anterior Descendent</td>
<td>26%</td>
<td>27%</td>
<td>21%</td>
<td></td>
</tr>
<tr>
<td>• Left Circumflex</td>
<td>20%</td>
<td>19%</td>
<td>21%</td>
<td></td>
</tr>
<tr>
<td>• Left Main</td>
<td>0.4%</td>
<td>0.4%</td>
<td>0.6%</td>
<td></td>
</tr>
<tr>
<td>• Saphenous Vein Graft</td>
<td>0.13%</td>
<td>0.13%</td>
<td>0.13%</td>
<td></td>
</tr>
<tr>
<td>• Other</td>
<td>1.4%</td>
<td>1.4%</td>
<td>1.5%</td>
<td></td>
</tr>
<tr>
<td>J-CTO score a</td>
<td>2.41 ± 1.28</td>
<td>2.23 ± 1.28</td>
<td>3.06 ± 1.11</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Progress CTO score a</td>
<td>1.09 ± 1.01</td>
<td>1.03 ± 0.99</td>
<td>1.43 ± 1.08</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

#AHA20

CAD: Coronary Artery Disease; LVEF: Left Ventricular Ejection Fraction; CABG: Coronary Artery Bypass Grafting; MI: Myocardial Infarction; a: mean ± standard deviation; b: median (interquartile ranges)
# Crossing strategies

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall (n= 7031)</th>
<th>Technical success (n= 6040)</th>
<th>Technical failure (n= 991)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful Crossing Strategy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Antegrade wiring</td>
<td>54%</td>
<td>61%</td>
<td>7%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>• Retrograde</td>
<td>20%</td>
<td>23%</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>• Antegrade dissection and re-entry</td>
<td>15%</td>
<td>16%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>• None</td>
<td>12%</td>
<td>0%</td>
<td>85%</td>
<td></td>
</tr>
<tr>
<td>First Crossing Strategy</td>
<td></td>
<td></td>
<td></td>
<td>0.0001</td>
</tr>
<tr>
<td>• Antegrade wiring</td>
<td>82%</td>
<td>83%</td>
<td>79%</td>
<td></td>
</tr>
<tr>
<td>• Retrograde</td>
<td>13%</td>
<td>12%</td>
<td>17%</td>
<td></td>
</tr>
<tr>
<td>• Antegrade dissection and re-entry</td>
<td>5%</td>
<td>5%</td>
<td>4%</td>
<td></td>
</tr>
</tbody>
</table>

Successful crossing strategies stratified by J-CTO score

J-CTO: Japan CTO score, AWE: antegrade, wire escalation, ADR: Antegrade dissection and re-entry
Successful crossing strategies stratified by PROGRESS-CTO score

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall (n=7031)</th>
<th>Technical success (n=6040)</th>
<th>Technical failure (n=991)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcification (moderate/severe)</td>
<td>42%</td>
<td>40%</td>
<td>52%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Proximal vessel tortuosity (moderate/severe)</td>
<td>26%</td>
<td>24%</td>
<td>34%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Proximal cap ambiguity</td>
<td>35%</td>
<td>32%</td>
<td>53%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>In-stent restenosis</td>
<td>16%</td>
<td>16%</td>
<td>19%</td>
<td>0.043</td>
</tr>
<tr>
<td>Prior failure to open CTO</td>
<td>20%</td>
<td>20%</td>
<td>24%</td>
<td>0.001</td>
</tr>
<tr>
<td>Side branch at the proximal cap</td>
<td>54%</td>
<td>52%</td>
<td>65%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Blunt/no stump, %</td>
<td>59%</td>
<td>57%</td>
<td>74%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Vessel diameter (mm) b</td>
<td>3.0 (2.5, 3.0)</td>
<td>3.0 (2.5, 3.0)</td>
<td>3.0 (2.5, 3.0)</td>
<td>0.099</td>
</tr>
<tr>
<td>Occlusion length (mm) b</td>
<td>25 (15, 40)</td>
<td>25 (15, 40)</td>
<td>30 (20, 50)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Number of stents used</td>
<td>2.3 ± 1.1</td>
<td>2.3 ± 1.1</td>
<td>2.1 ± 1.2</td>
<td>0.283</td>
</tr>
</tbody>
</table>

CTO: Chronic Total Occlusion; b: median (interquartile ranges)
### Procedural Outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Success</td>
<td>85.9%</td>
</tr>
<tr>
<td>Procedural Success</td>
<td>83.8%</td>
</tr>
<tr>
<td>Procedural time (min) b</td>
<td>115 (75, 170)</td>
</tr>
<tr>
<td>Fluoroscopy time (min) b</td>
<td>43 (26, 70)</td>
</tr>
<tr>
<td>Air kerma radiation dose (Gray) b</td>
<td>2.30 (1.30, 3.90)</td>
</tr>
<tr>
<td>Contrast volume b</td>
<td>225 (160, 305)</td>
</tr>
<tr>
<td>MACE b</td>
<td>2.06%</td>
</tr>
</tbody>
</table>

**MACE:** Major Cardiac Adverse Events  

b: median (interquartile ranges)

### Complications

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>MACE</td>
<td>2.06%</td>
</tr>
<tr>
<td>Death</td>
<td>0.39%</td>
</tr>
<tr>
<td>Acute Q wave MI</td>
<td>0.01%</td>
</tr>
<tr>
<td>Acute MI</td>
<td>0.64%</td>
</tr>
<tr>
<td>Re-PCI</td>
<td>0.17%</td>
</tr>
<tr>
<td>Stroke</td>
<td>0.02%</td>
</tr>
<tr>
<td>Emergency CABG</td>
<td>0.01%</td>
</tr>
<tr>
<td>Pericardiocentesis</td>
<td>0.85%</td>
</tr>
<tr>
<td>Perforation</td>
<td>4.85%</td>
</tr>
<tr>
<td>Dissection/Thrombus of Donor Artery</td>
<td>0.79%</td>
</tr>
</tbody>
</table>

**MACE:** Major Cardiac Adverse Events
**Procedural outcomes across JCTO and PROGRESS CTO score strata**

(J-CTO: Japan Chronic Total Occlusion score, PROGRESS CTO: Prospective Global Registry for the Study of Chronic Total Occlusion Intervention score)

**Limitations**

1. Observational registry without adjudication of clinical events by an independent committee

2. Quantitative coronary angiographic analyses were not performed

3. Procedures were performed by experienced CTO PCI operators, limiting extrapolation of the results in less experienced centers and operators
Conclusions

Using a combination of crossing strategies, high success and acceptable complication rates can be achieved in CTO PCI among various centers and patient populations.

Thank you for your attention!

www.progresscto.org

j grit.karacsonyi8@gmail.com
Outcomes of Patients with ST Elevation Myocardial Infarction and History of Prior Coronary Artery Bypass Graft Surgery

Judit Karacsonyi, MD, PhD\textsuperscript{1,2} on behalf of the Midwest STEMI consortium

\textsuperscript{1}Minneapolis Heart Institute and Minneapolis Heart Institute Foundation, Abbott Northwestern Hospital, Minneapolis, MN, USA
\textsuperscript{2}Division of Invasive Cardiology, Second Department of Internal Medicine and Cardiology Center, University of Szeged, Szeged, Hungary

Coauthors:

Christian W. Schmidt, MS
Santiago Garcia, MD
Timothy D. Henry, MD
Bavana V. Rangan, BDS, MPH
Ilias D. Nikolopoulos, MD
Evangelia Vemmou, MD
Iosif Xenogiannis, MD, PhD
Mario Goessl, MD, PhD
Paul Sorajja, MD
Ivan G. Chavez, MD
Michael R. Mooney, MD
Anil Poulose, MD
Jay Traverse, MD

Yale L. Wang, MD
Kenneth W. Baran, MD
Steven Bradley, MD, MPH
Michael Megaly, MD, MS
Ross F. Garberich, MS
Imre Ungi, MD, PhD
M. Nicholas Burke, MD
Emmanouil S. Brilakis, MD, PhD
Disclosure Statement of Financial Interest

I, Judit Karacsonyi DO NOT have a financial interest/arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation.

Introduction

The outcomes of STEMI patients with prior CABG surgery have received limited study.

Stone et al. PAMI-2 trial
(Second Primary Angioplasty in Myocardial Infarction)

Iqbal et al.

Kohl et. al Midwest STEMI

But no significant difference in 30-day mortality and in-hospital MACE after propensity-matching

<table>
<thead>
<tr>
<th>30 Days</th>
<th>P &lt; 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>0.42</td>
</tr>
<tr>
<td>MI</td>
<td>0.42</td>
</tr>
<tr>
<td>Stroke</td>
<td>0.05</td>
</tr>
<tr>
<td>Reinfarction</td>
<td>0.17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1 Year</th>
<th>P &lt; 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>0.39</td>
</tr>
<tr>
<td>MI</td>
<td>0.39</td>
</tr>
<tr>
<td>Stroke</td>
<td>0.08</td>
</tr>
<tr>
<td>Reinfarction</td>
<td>0.50</td>
</tr>
<tr>
<td>MACE</td>
<td>0.03</td>
</tr>
<tr>
<td>Death in 5 years</td>
<td>0.001</td>
</tr>
</tbody>
</table>
Continuous variables are presented as mean ± SD or median (interquartile range) and compared using the student’s t-test, or Wilcoxon rank-sum test, as appropriate.

Categorical data are reported as frequencies or percentages and compared using the chi-square test or Fisher’s exact test, as appropriate.

The incidence of events was assessed using the Kaplan Meier method and compared using the log-rank test and Cox proportional hazards models.
**Methods**

- **DESIGN**: Prospective, multi-center registry, Midwest STEMI Consortium (MSC) 4 large, regional STEMI systems of care with similar standardized STEMI protocols
- Present project is Level 1 analyses of the Minneapolis Heart Institute patients
- **OBJECTIVE**: to compare the clinical and procedural characteristics and outcomes of STEMI patients with and without prior CABG surgery enrolled in a contemporary STEMI registry between March 2003 and April 2020.

---

### Results: Baseline clinical characteristics I.

<table>
<thead>
<tr>
<th>Variable</th>
<th>No Prior CABG (n=5877)</th>
<th>Prior CABG (n=434)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD</td>
<td>62.9 ± 13.9</td>
<td>70.4 ± 11.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>4138 (70)</td>
<td>348 (80)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BMI, mean ± SD</td>
<td>29.1 ± 6.1</td>
<td>29.0 ± 5.8</td>
<td>0.769</td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td>3318 (57)</td>
<td>368 (85)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Dyslipidemia, n (%)</td>
<td>3029 (52)</td>
<td>384 (89)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes, n (%)</td>
<td>1049 (18)</td>
<td>167 (39)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hx CAD, n (%)</td>
<td>1501 (26)</td>
<td>434 (100)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Family Hx CAD, n (%)</td>
<td>2394 (45)</td>
<td>197 (50)</td>
<td>0.033</td>
</tr>
<tr>
<td>Hx CHF, n (%)</td>
<td>450 (8)</td>
<td>84 (19)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hx Smoking, n (%)</td>
<td>3581 (61)</td>
<td>277 (64)</td>
<td>0.218</td>
</tr>
<tr>
<td>Current smoker, n (%)</td>
<td>2026 (57)</td>
<td>80 (29)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Previous MI, n (%)</td>
<td>1044 (18)</td>
<td>284 (68)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Previous PCI, n (%)</td>
<td>1164 (20)</td>
<td>239 (56)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

---

BMI: Body Mass Index; CAD: Coronary Artery Disease; CABG: Coronary Artery Bypass Grafting; MI: Myocardial Infarction; CHF: congestive heart failure; Hx: History of; MI: Myocardial Infarction; PCI: Percutaneous
### Results: Baseline clinical characteristics II.

<table>
<thead>
<tr>
<th>Variable</th>
<th>No Prior CABG (n=5877)</th>
<th>Prior CABG (n=434)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hx Stroke, n (%)</td>
<td>218 (4)</td>
<td>37 (9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cardiogenic Shock pre-PCI, n (%)</td>
<td>549 (9)</td>
<td>61 (14)</td>
<td>0.001</td>
</tr>
<tr>
<td>Cardiac Arrest pre-PCI, n (%)</td>
<td>585 (10)</td>
<td>53 (12)</td>
<td>0.133</td>
</tr>
<tr>
<td>Anterior MI, n (%)</td>
<td>2125 (36)</td>
<td>104 (24)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Killip Class, n (%)</td>
<td>5117 (87)</td>
<td>355 (82)</td>
<td>0.002</td>
</tr>
<tr>
<td>0-1</td>
<td>755 (13)</td>
<td>78 (18)</td>
<td></td>
</tr>
<tr>
<td>Aspirin, n (%)</td>
<td>1707 (39)</td>
<td>265 (81)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Beta-blocker, n (%)</td>
<td>1244 (28)</td>
<td>243 (74)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ACE-inhibitor, n (%)</td>
<td>985 (22)</td>
<td>155 (47)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ARB, n (%)</td>
<td>186 (4)</td>
<td>21 (6)</td>
<td>0.060</td>
</tr>
<tr>
<td>Statin, n (%)</td>
<td>1405 (32)</td>
<td>240 (73)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Antiplatelet, n (%)</td>
<td>343 (8)</td>
<td>89 (27)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

**MI**: Myocardial Infarction; PCI: Percutaneous Coronary Intervention; ACE: acetylcholinesterase; ARB: Angiotensin II receptor Blocker

### Angiographic characteristics I.

<table>
<thead>
<tr>
<th>Variable</th>
<th>No Prior CABG (n=5877)</th>
<th>Prior CABG (n=434)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No clear culprit artery, n (%)</td>
<td>870 (15)</td>
<td>97 (23)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>TIMI flow pre-PCI, n (%)</td>
<td>2884 (53)</td>
<td>160 (42)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>0/1</td>
<td>2519 (47)</td>
<td>217 (58)</td>
<td></td>
</tr>
<tr>
<td>2/3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIMI flow post-PCI, n (%)</td>
<td>114 (2)</td>
<td>15 (4)</td>
<td>0.018</td>
</tr>
<tr>
<td>0/1</td>
<td>5284 (98)</td>
<td>362 (96)</td>
<td></td>
</tr>
<tr>
<td>2/3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak CK, median (IQR)</td>
<td>791 (262, 1818)</td>
<td>428 (147, 1171)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Peak CK-MB, median (IQR)</td>
<td>73 (20, 181)</td>
<td>41 (8, 111)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ejection Fraction, median (IQR)</td>
<td>50 (40, 60)</td>
<td>48 (35, 58)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PPCI performed, n (%)</td>
<td>4676 (80)</td>
<td>293 (68)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Length of stay, median (IQR)</td>
<td>3 (2, 4)</td>
<td>3 (2, 5)</td>
<td>0.032</td>
</tr>
<tr>
<td>Door to Balloon, min</td>
<td>55 (41, 79)</td>
<td>69 (52, 88)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

**TIMI**: thrombolysis in myocardial infarction; PCI: Percutaneous Coronary Intervention; CK: creatine kinase; CK-MB: creatine kinase myoglobin-binding; IQR: interquartile ranges
## Angiographic and Clinical Outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>No Prior CABG (n=5877)</th>
<th>Prior CABG (n=434)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In hospital</td>
<td>319 (5)</td>
<td>40 (9)</td>
<td>0.001</td>
</tr>
<tr>
<td>30-day</td>
<td>374 (6)</td>
<td>47 (11)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>1-year</td>
<td>544 (9)</td>
<td>74 (17)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>5-year</td>
<td>818 (14)</td>
<td>124 (29)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Outcomes at 30 days, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac Readmission</td>
<td>313 (6)</td>
<td>24 (6)</td>
<td>0.680</td>
</tr>
<tr>
<td>Stroke</td>
<td>56 (1)</td>
<td>5 (1)</td>
<td>0.610</td>
</tr>
<tr>
<td>Re-infarction</td>
<td>82 (2)</td>
<td>5 (1)</td>
<td>0.752</td>
</tr>
<tr>
<td>Re-ischemia</td>
<td>74 (1)</td>
<td>6 (2)</td>
<td>0.744</td>
</tr>
<tr>
<td>Death</td>
<td>59 (1)</td>
<td>7 (2)</td>
<td>0.185</td>
</tr>
<tr>
<td>MACE</td>
<td>199 (4)</td>
<td>17 (5)</td>
<td>0.431</td>
</tr>
<tr>
<td>Outcomes at 1-year, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac Readmission</td>
<td>844 (16)</td>
<td>90 (24)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Stroke</td>
<td>89 (2)</td>
<td>13 (3)</td>
<td>0.011</td>
</tr>
<tr>
<td>Re-infarction</td>
<td>165 (3)</td>
<td>23 (6)</td>
<td>0.001</td>
</tr>
<tr>
<td>Re-ischemia</td>
<td>184 (3)</td>
<td>23 (6)</td>
<td>0.008</td>
</tr>
<tr>
<td>Death</td>
<td>225 (4)</td>
<td>34 (9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MACE</td>
<td>461 (9)</td>
<td>67 (18)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Death at 5-year, n (%)</td>
<td>497 (9)</td>
<td>84 (22)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Length of follow-up, median (IQR)</td>
<td>401 (365, 1826)</td>
<td>367 (365, 1706)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

MACE: Major Cardiac Adverse Events; IQR: interquartile ranges

### Clinical outcomes after Cox Proportional Hazard Analyses

<table>
<thead>
<tr>
<th>Prior CABG</th>
<th>Odds ratio</th>
<th>Std. Error</th>
<th>z</th>
<th>p-value</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality In hospital</td>
<td>1.26</td>
<td>0.31</td>
<td>0.93</td>
<td>0.353</td>
<td>0.78 – 2.04</td>
</tr>
<tr>
<td>Mortality between discharge and 18 months</td>
<td>1.25</td>
<td>0.23</td>
<td>1.23</td>
<td>0.218</td>
<td>0.87 – 1.80</td>
</tr>
<tr>
<td>Mortality between 18 months and 5 years</td>
<td>1.96</td>
<td>0.35</td>
<td>3.71</td>
<td>&lt;0.001</td>
<td>1.37 – 2.79</td>
</tr>
</tbody>
</table>
Kaplan-Meier curves of freedom from death in STEMI patients with vs. without prior CABG during 5 year follow up

Survival

<table>
<thead>
<tr>
<th>Time (years)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>p&lt;0.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Proportion Surviving

- No Prior CABG
- Prior CABG

CABG: coronary artery bypass surgery, STEMI: ST elevation myocardial infarction

Kaplan-Meier curves of freedom from MACE in STEMI patients with vs. without prior CABG during 5 year follow up

Freedom from MACE

<table>
<thead>
<tr>
<th>Time (years)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>p&lt;0.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Proportion Surviving

- No Prior CABG
- Prior CABG

CABG: coronary artery bypass surgery, MACE: major cardiac adverse events; STEMI: ST elevation myocardial infarction
Kaplan-Meier curves of freedom from death in STEMI patients with prior CABG and native coronary culprit vessel vs. saphenous vein graft culprit vessel vs. no culprit vessel.

CABG: coronary artery bypass surgery, STEMI: ST elevation myocardial infarction

Kaplan-Meier curves of freedom MACE in STEMI patients with prior CABG and native coronary culprit vessel vs. saphenous vein graft culprit vessel vs. no culprit vessel.

CABG: coronary artery bypass surgery, MACE: major cardiac adverse events; STEMI: ST elevation myocardial infarction
Limitations

1. Observational study and hence susceptible to unmeasured confounding and selection bias.

2. Core-laboratory adjudication was not performed.

Conclusions

Early and long term outcomes after STEMI were worse among patients with prior CABG compared to patients without prior CABG, at least partly due to higher risk baseline characteristics.
Thank you for your attention!

judit.karacsonyi8@gmail.com

Radial Versus Femoral Access for Coronary Procedures in Patients with Prior Coronary Artery Bypass Grafting Surgery: An Updated Study-Level Meta-analysis

Background-RCTs

A Randomized Comparison of the Transradial and Transfemoral Approaches for Coronary Artery Bypass Graft Angiography and Intervention

The RADIAL-CABG Trial (RADIAL Versus Femoral Access for Coronary Artery Bypass Graft Angiography and Intervention)

Toftdahl T, Michael MD, Motti MD, Mohamed Alasmar MD, Antonio Pugliese MD, Owen Mogulbaj MD, Vishal G. Patel MD, Bavo V. Ragun, BDS, MPHI, Michael Larsen MD, Jeffrey L. Haring, MD, Jerrod Goodin, MD, Shashit Ahdelil, MD, Subhash Banerji, MD, Emmanuel S. Brilakis, MD, PhD

Conclusions In patients who had previously undergone CABG surgery, transradial diagnostic coronary angiography was associated with greater contrast use, longer procedure time, and greater access crossover and operator radiation exposure compared with transfemoral angiography.

Radial < Femoral

Radial non inferior

Background-Observational

Meta-Analysis of Radial Versus Femoral Artery Approach for Coronary Procedures in Patients With Previous Coronary Artery Bypass Grafting

Stefano Rieti, MD, PhD, ** Alessandro Scialfa, MD, FFE, Emmanuel S. Brilakis, MD, PhD, Francesco Basietto, MD, PhD, Sudhir Rathor, MD, Francesco R. Pagliaro, MD, Silva Felede, MD, Antonio G. Zanin, MD, Yu J. Zhao, MD, Luis A. Geiman, MD, and Richard A. Anderson, MD

Radial: Less vascular access complications
Radial vs femoral debate

Research question

In patients with prior bypass surgery who undergo coronary angiography and/or percutaneous coronary intervention, is femoral or radial access associated with better outcomes?
SEARCH STRATEGY

**PubMed Search**
- ("radial"[Title] AND "femoral"[Title] AND ("graft"[Title] OR "grafts"[Title] OR "bypass"[Title]))
  OR
- ("transradial"[Title] AND "transfemoral"[Title] AND ("graft"[Title] OR "grafts"[Title] OR "bypass"[Title]))
  OR
- ("access"[Title] AND ("graft"[Title] OR "grafts"[Title] OR "bypass"[Title]))
  + "similar articles" section
  + references from selected papers

**Clinicaltrials.gov search**
(radial OR femoral) AND (bypass OR graft) AND access

**Cochrane Library search**
(radial OR femoral) AND (bypass OR graft) AND access

**Conference abstracts**
TCT, ACC Scientific Session, SCAI Scientific Sessions

**Previous RCTs**
Prior CABG data from 4 radial vs femoral RCT requested

INCLUSION CRITERIA

Studies comparing RA with FA for coronary angiography (CA) and/or percutaneous coronary intervention (PCI) in patients with previous CABG with at least 1 of the following outcomes reported:

1. Procedural time;
2. Contrast volume;
3. Crossover rate to a different vascular access; and

Methods

760 articles identified
- 704 from PubMed
- 52 from Clinicaltrials.gov
- 4 from Cochrane

- 738 excluded as irrelevant through title and/or abstract screening
- 5 excluded as duplicates

Subgroup data from 1 radial vs femoral study (RIFLE-STEACS) received

3 conference abstracts

21 studies assessed according to inclusion criteria
Methods

BIAS ANALYSIS
- Cochrane Risk of Bias 2 Tool
- Newcastle- Ottawa Scale
- Publication bias assessment

FREQUENTIST METAANALYSIS
- Random effects (DerSimonian and Laird)
- Revman 5

METAREGRESSION
- Random effects (DerSimonian and Laird)
- JASP 0.14 (metaBMA)

BAYESIAN METAANALYSIS
- Random effects
- JASP 0.14 (metaMAN)

Bias-RCTs

<table>
<thead>
<tr>
<th>Study</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michael et al</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Romagnoli et al</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Tsikas et al</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Risk of bias domains:
- D1: Bias arising from the randomization process
- D2: Bias due to deviations from intended intervention
- D3: Bias due to missing outcome data
- D4: Bias in measurement of the outcome
- D5: Bias in selection of the reported result

Judgement: Low
### Bias-observational

<table>
<thead>
<tr>
<th>Study</th>
<th>Selection</th>
<th>Comparability</th>
<th>Outcome</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amro et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Balaban et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Bundhoo et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Burzotta et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Dai et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Duarte et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Han et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>He et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Hirzallah et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Israeli et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Januszek et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Kabir et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Kinnaird et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Orlev et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Pasley et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Rathore et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Sanmartin et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Ziakas et al</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
</tbody>
</table>

**Newcastle Ottawa scale maximum=9**

### Publication bias (Egger’s test)

**ACCESS COMPLICATIONS**

- Effect size (logOR) vs. Standard Error
- P-value = 0.4

**CROSSOVER RATES**

- Effect size (logOR) vs. Standard Error
- P-value < 0.001
Publication bias (Egger’s test)

PROCEDURE TIME

CONTRAST VOLUME

Randomized studies

ACCESS COMPLICATIONS

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Radial Events</th>
<th>Radial Total</th>
<th>Femoral Events</th>
<th>Femoral Total</th>
<th>Weight</th>
<th>M-H, Random, 95% CI</th>
<th>Odds Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michael et al</td>
<td>2</td>
<td>64</td>
<td>2</td>
<td>64</td>
<td>4.6%</td>
<td>1.00 [0.14, 7.33]</td>
<td></td>
</tr>
<tr>
<td>Romagnoli et al</td>
<td>1</td>
<td>7</td>
<td>2</td>
<td>12</td>
<td>3.3%</td>
<td>0.83 [0.06, 11.26]</td>
<td></td>
</tr>
<tr>
<td>Tsikias et al</td>
<td>4</td>
<td>75</td>
<td>3</td>
<td>75</td>
<td>6.0%</td>
<td>1.35 [0.29, 6.26]</td>
<td></td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>146</td>
<td>151</td>
<td>13.9%</td>
<td></td>
<td>1.13 [0.38, 3.40]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.00, Chi² = 0.12, df = 2 (P = 0.94), I² = 0%

Test for overall effect: Z = 0.22 (P = 0.83)

Radial better  Femoral better
Randomized studies

**PROCEDURE TIME**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Radial Mean</th>
<th>SD</th>
<th>Total</th>
<th>Femoral Mean</th>
<th>SD</th>
<th>Total</th>
<th>Mean Difference</th>
<th>IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michael et al</td>
<td>34.2</td>
<td>14.7</td>
<td>64</td>
<td>21.9</td>
<td>6.8</td>
<td>64</td>
<td>10.2%</td>
<td>12.30 [8.33, 16.27]</td>
</tr>
<tr>
<td>Romagnoli et al</td>
<td>91</td>
<td>51</td>
<td>7</td>
<td>77</td>
<td>26</td>
<td>12</td>
<td>0.3%</td>
<td>14.60 [-26.54, 54.54]</td>
</tr>
<tr>
<td>Toğkas et al</td>
<td>13</td>
<td>5.3</td>
<td>75</td>
<td>13.5</td>
<td>6.5</td>
<td>75</td>
<td>13.5%</td>
<td>-6.50 [-2.40, 1.40]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>146</td>
<td>151</td>
<td></td>
<td>151</td>
<td>24.0</td>
<td></td>
<td>6.37 [-5.52, 18.27]</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: $\hat{\tau}^2 = 76.98; \chi^2 = 32.87, df = 2 (P = 0.00001); I^2 = 84$

Test for overall effect: $Z = 1.05 (P = 0.29)$

Radial better, Femoral better

---

Randomized studies

**CONTRAST VOLUME**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Radial Mean</th>
<th>SD</th>
<th>Total</th>
<th>Femoral Mean</th>
<th>SD</th>
<th>Total</th>
<th>Mean Difference</th>
<th>IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michael et al</td>
<td>171</td>
<td>72</td>
<td>64</td>
<td>142</td>
<td>39</td>
<td>64</td>
<td>5.3%</td>
<td>29.00 [19.84, 49.06]</td>
</tr>
<tr>
<td>Romagnoli et al</td>
<td>372</td>
<td>129</td>
<td>7</td>
<td>238</td>
<td>67</td>
<td>12</td>
<td>0.3%</td>
<td>74.80 [28.81, 176.81]</td>
</tr>
<tr>
<td>Toğkas et al</td>
<td>122.1</td>
<td>60.9</td>
<td>74</td>
<td>122.0</td>
<td>52.6</td>
<td>75</td>
<td>6.0%</td>
<td>-10.70 [-28.97, 7.57]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>145</td>
<td>151</td>
<td></td>
<td>151</td>
<td>11.6</td>
<td></td>
<td>15.73 [21.55, 53.00]</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: $\hat{\tau}^2 = 712.08; \chi^2 = 8.02, df = 2 (P = 0.048); I^2 = 80$

Test for overall effect: $Z = 0.83 (P = 0.41)$

Radial better, Femoral better
### Randomized studies

**CROSSOVER RATE**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Radial Events</th>
<th>Radial Total</th>
<th>Femoral Events</th>
<th>Femoral Total</th>
<th>Weight</th>
<th>Odds Ratio</th>
<th>M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michael et al</td>
<td>11</td>
<td>64</td>
<td>0</td>
<td>64</td>
<td>5.4%</td>
<td>27.73</td>
<td>[1.60, 481.55]</td>
</tr>
<tr>
<td>Romagnoli et al</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>12</td>
<td>6.0%</td>
<td>4.40</td>
<td>[0.32, 60.61]</td>
</tr>
<tr>
<td>Tsigkas et al</td>
<td>2</td>
<td>75</td>
<td>0</td>
<td>75</td>
<td>4.9%</td>
<td>5.14</td>
<td>[0.24, 108.81]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td></td>
<td></td>
<td>146</td>
<td>151</td>
<td>16.3%</td>
<td>8.40</td>
<td>[1.64, 42.95]</td>
</tr>
<tr>
<td>Total events</td>
<td>15</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.00; Chi² = 1.14, df = 2 (P = 0.57); P = 0%
Test for overall effect: Z = 2.55 (P = 0.01)

Radial better Femoral better

---

### Observational studies

**ACCESS COMPLICATIONS**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Radial Events</th>
<th>Radial Total</th>
<th>Femoral Events</th>
<th>Femoral Total</th>
<th>Weight</th>
<th>Odds Ratio</th>
<th>M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balaban et al</td>
<td>44</td>
<td>168</td>
<td>16</td>
<td>174</td>
<td>9.7%</td>
<td>3.50</td>
<td>[1.86, 6.58]</td>
</tr>
<tr>
<td>Bhandari et al</td>
<td>0</td>
<td>97</td>
<td>3</td>
<td>209</td>
<td>2.7%</td>
<td>0.26</td>
<td>[0.02, 5.99]</td>
</tr>
<tr>
<td>Buzatte et al</td>
<td>0</td>
<td>20</td>
<td>2</td>
<td>38</td>
<td>2.5%</td>
<td>0.26</td>
<td>[0.02, 7.76]</td>
</tr>
<tr>
<td>Cai et al</td>
<td>2</td>
<td>93</td>
<td>2</td>
<td>91</td>
<td>4.6%</td>
<td>0.90</td>
<td>[0.13, 7.15]</td>
</tr>
<tr>
<td>Han et al</td>
<td>2</td>
<td>68</td>
<td>8</td>
<td>56</td>
<td>5.6%</td>
<td>0.10</td>
<td>[0.04, 0.95]</td>
</tr>
<tr>
<td>He et al</td>
<td>8</td>
<td>113</td>
<td>32</td>
<td>261</td>
<td>8.9%</td>
<td>0.62</td>
<td>[0.26, 1.38]</td>
</tr>
<tr>
<td>Huzaili et al</td>
<td>0</td>
<td>216</td>
<td>19</td>
<td>1907</td>
<td>2.9%</td>
<td>0.22</td>
<td>[0.01, 3.78]</td>
</tr>
<tr>
<td>Israel Z</td>
<td>15</td>
<td>863</td>
<td>38</td>
<td>819</td>
<td>9.7%</td>
<td>0.27</td>
<td>[0.16, 0.52]</td>
</tr>
<tr>
<td>Januski et al</td>
<td>19</td>
<td>17094</td>
<td>24</td>
<td>17154</td>
<td>9.7%</td>
<td>0.60</td>
<td>[0.37, 1.20]</td>
</tr>
<tr>
<td>Konrad et al</td>
<td>22</td>
<td>7168</td>
<td>130</td>
<td>11881</td>
<td>10.3%</td>
<td>0.27</td>
<td>[0.17, 0.43]</td>
</tr>
<tr>
<td>Orav et al</td>
<td>2</td>
<td>164</td>
<td>20</td>
<td>367</td>
<td>6.3%</td>
<td>0.16</td>
<td>[0.04, 0.77]</td>
</tr>
<tr>
<td>Ratcliffe et al</td>
<td>2</td>
<td>51</td>
<td>18</td>
<td>64</td>
<td>5.9%</td>
<td>0.22</td>
<td>[0.05, 1.00]</td>
</tr>
<tr>
<td>Sannad et al</td>
<td>1</td>
<td>151</td>
<td>1</td>
<td>153</td>
<td>3.0%</td>
<td>1.01</td>
<td>[0.06, 16.55]</td>
</tr>
<tr>
<td>Zia et al</td>
<td>1</td>
<td>132</td>
<td>4</td>
<td>263</td>
<td>4.1%</td>
<td>0.36</td>
<td>[0.04, 3.42]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td></td>
<td></td>
<td>118</td>
<td>309</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.61; Chi² = 55.99, df = 11 (P < 0.00001); P = 77%
Test for overall effect: Z = 2.43 (P = 0.02)

Radial better Femoral better
### Observational studies

**CONTRAST VOLUME**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Radial Events</th>
<th>Total</th>
<th>Femoral Events</th>
<th>Total</th>
<th>Odds Ratio M.H. Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amro et al</td>
<td>119.39</td>
<td>58.87</td>
<td>49</td>
<td>127.43</td>
<td>68.26</td>
</tr>
<tr>
<td>Bankon et al</td>
<td>58.5</td>
<td>11.06</td>
<td>268</td>
<td>59</td>
<td>9.31</td>
</tr>
<tr>
<td>Del et al</td>
<td>201.5</td>
<td>45.51</td>
<td>92</td>
<td>221.5</td>
<td>45.81</td>
</tr>
<tr>
<td>Dua et al</td>
<td>176.54</td>
<td>121.63</td>
<td>251</td>
<td>192.62</td>
<td>121.83</td>
</tr>
<tr>
<td>Hicakli et al</td>
<td>120.9</td>
<td>58.16</td>
<td>216</td>
<td>116.3</td>
<td>74.4</td>
</tr>
<tr>
<td>Israeli et al</td>
<td>204.7</td>
<td>176.9</td>
<td>17004</td>
<td>212</td>
<td>86.01</td>
</tr>
<tr>
<td>Janasz et al</td>
<td>357</td>
<td>154</td>
<td>51</td>
<td>346</td>
<td>195.76</td>
</tr>
<tr>
<td>Sammarco et al</td>
<td>178.6</td>
<td>64.4</td>
<td>151</td>
<td>184.5</td>
<td>77.23</td>
</tr>
<tr>
<td>Zikias et al</td>
<td>233</td>
<td>91</td>
<td>132</td>
<td>234</td>
<td>91</td>
</tr>
</tbody>
</table>

**CROSSOVER RATE**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Radial Events</th>
<th>Total</th>
<th>Femoral Events</th>
<th>Total</th>
<th>Odds Ratio M.H. Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amro et al</td>
<td>3</td>
<td>49</td>
<td>535</td>
<td>5.16</td>
<td>50.61</td>
</tr>
<tr>
<td>Bankon et al</td>
<td>3</td>
<td>97</td>
<td>364</td>
<td>7.39</td>
<td>6.61</td>
</tr>
<tr>
<td>Del et al</td>
<td>3</td>
<td>92</td>
<td>91</td>
<td>3.53</td>
<td>15.07</td>
</tr>
<tr>
<td>Han et al</td>
<td>1</td>
<td>60</td>
<td>55</td>
<td>4.55</td>
<td>2.82</td>
</tr>
<tr>
<td>Hid et al</td>
<td>3</td>
<td>113</td>
<td>357</td>
<td>5.16</td>
<td>29.66</td>
</tr>
<tr>
<td>Israeli Z</td>
<td>24</td>
<td>863</td>
<td>10</td>
<td>618</td>
<td>16.06</td>
</tr>
<tr>
<td>Pastak et al</td>
<td>3</td>
<td>72</td>
<td>254</td>
<td>5.16</td>
<td>25.63</td>
</tr>
<tr>
<td>Rathore et al</td>
<td>3</td>
<td>51</td>
<td>64</td>
<td>5.56</td>
<td>9.31</td>
</tr>
<tr>
<td>Sammarco et al</td>
<td>6</td>
<td>151</td>
<td>2</td>
<td>153</td>
<td>10.44</td>
</tr>
<tr>
<td>Zikias et al</td>
<td>5</td>
<td>132</td>
<td>202</td>
<td>5.25</td>
<td>17.47</td>
</tr>
</tbody>
</table>

Total events: 63, 71

Heterogeneity: Tau^2 = 0.94, Chi^2 = 25.58, df = 10 (P = 0.02), *P* = 5.4

Test for overall effect Z = 3.50 (P = 0.0005)
### Observational studies

**PROCEDURE TIME**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Radial</th>
<th>Femoral</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Events</td>
<td>Total Weight</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Total</td>
<td>M.H. Random, 95% CI</td>
</tr>
<tr>
<td>Arntz et al</td>
<td>39.63</td>
<td>26.43</td>
<td>49.43</td>
</tr>
<tr>
<td>Dalmé et al</td>
<td>20.08</td>
<td>4.3</td>
<td>268.17</td>
</tr>
<tr>
<td>Gurosz et al</td>
<td>21</td>
<td>10.4</td>
<td>22</td>
</tr>
<tr>
<td>Dell et al</td>
<td>70.1</td>
<td>15.8</td>
<td>80.9</td>
</tr>
<tr>
<td>Han et al</td>
<td>49</td>
<td>23.7</td>
<td>80</td>
</tr>
<tr>
<td>Hitzel et al</td>
<td>41.5</td>
<td>26.2</td>
<td>67.7</td>
</tr>
<tr>
<td>Habib et al</td>
<td>49</td>
<td>20</td>
<td>64</td>
</tr>
<tr>
<td>Rathore et al</td>
<td>52.1</td>
<td>29.5</td>
<td>81.6</td>
</tr>
<tr>
<td>Sarradin et al</td>
<td>41.4</td>
<td>22.3</td>
<td>151</td>
</tr>
<tr>
<td>Zilakas et al</td>
<td>68</td>
<td>27.2</td>
<td>135</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>1162</td>
<td>3296</td>
<td>76.0%</td>
</tr>
</tbody>
</table>

Heterogeneity: $Q = 25.80, \chi^2 = 13.75, df = 9 (P = 0.133), I^2 = 35%$

Test for overall effect $Z = 1.35 (P = 0.18)$

---

### Meta-regression to explain heterogeneity

**ACCESS COMPLICATIONS**

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>17.365</td>
<td>23.314</td>
<td>0.456</td>
</tr>
<tr>
<td>% of GP IIb/IIIa inhibitors</td>
<td>-0.038</td>
<td>0.036</td>
<td>0.287</td>
</tr>
<tr>
<td>% Men</td>
<td>-0.049</td>
<td>0.126</td>
<td>0.699</td>
</tr>
<tr>
<td>Mean age</td>
<td>-0.159</td>
<td>0.043</td>
<td>0.513</td>
</tr>
<tr>
<td>% ACS</td>
<td>-0.029</td>
<td>0.035</td>
<td>0.406</td>
</tr>
<tr>
<td>Arterial graft presence (YES)</td>
<td>-1.984</td>
<td>2.803</td>
<td>0.479</td>
</tr>
<tr>
<td>Randomized (YES)</td>
<td>5.654</td>
<td>4.409</td>
<td>0.200</td>
</tr>
</tbody>
</table>

---

**CROSSOVER RATE**

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>50.709</td>
<td>78.489</td>
<td>0.518</td>
</tr>
<tr>
<td>Mean age</td>
<td>-0.734</td>
<td>0.965</td>
<td>0.447</td>
</tr>
<tr>
<td>% of GP IIb/IIIa inhibitors</td>
<td>-0.100</td>
<td>0.176</td>
<td>0.570</td>
</tr>
<tr>
<td>% ACS</td>
<td>0.077</td>
<td>0.075</td>
<td>0.303</td>
</tr>
<tr>
<td>Randomized (YES)</td>
<td>7.264</td>
<td>17.797</td>
<td>0.683</td>
</tr>
<tr>
<td>Arterial graft presence (YES)</td>
<td>-6.137</td>
<td>10.038</td>
<td>0.541</td>
</tr>
</tbody>
</table>

---

*Note: $p$-values are approximate.*
### Meta-regression to explain heterogeneity

**PROCEDURE TIME**

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>98.926</td>
<td>42.064</td>
<td>0.019</td>
</tr>
<tr>
<td>Mean age</td>
<td>-1.514</td>
<td>0.648</td>
<td>0.019</td>
</tr>
<tr>
<td>% PCI</td>
<td>-0.038</td>
<td>0.051</td>
<td>0.463</td>
</tr>
<tr>
<td>% ACS</td>
<td>0.134</td>
<td>0.092</td>
<td>0.147</td>
</tr>
<tr>
<td>Randomized (YES)</td>
<td>14.531</td>
<td>3.597 &lt; .001</td>
<td></td>
</tr>
<tr>
<td>Arterial graft presence (YES)</td>
<td>-4.866</td>
<td>3.863 0.208</td>
<td></td>
</tr>
</tbody>
</table>

Omnibus test of Model Coefficients: 18.551 < .001

Test of Residual Heterogeneity: 6.301 1 0.012

*Note: p-values are approximate.*

**CONTRAST VOLUME**

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-42.195</td>
<td>30.247</td>
<td>0.163</td>
</tr>
<tr>
<td>% PCI</td>
<td>-0.181</td>
<td>0.571</td>
<td>0.751</td>
</tr>
<tr>
<td>% ACS</td>
<td>0.839</td>
<td>1.084</td>
<td>0.439</td>
</tr>
<tr>
<td>Randomized (YES)</td>
<td>48.711</td>
<td>34.139</td>
<td>0.154</td>
</tr>
<tr>
<td>Arterial graft presence (YES)</td>
<td>-2.018</td>
<td>20.298 0.921</td>
<td></td>
</tr>
</tbody>
</table>

Omnibus test of Model Coefficients: 11.640 4 0.026

Test of Residual Heterogeneity: 50.782 2 < .001

*Note: p-values are approximate.*

---

### Random effects Bayesian meta-analysis

**ACCESS COMPLICATIONS**

Non informative prior - Cauchy(0, .707)

**CROSSOVER RATES**

BF$_{10}$ interpretation

Random effects Bayesian meta-analysis

Non informative prior - Cauchy(0,.707)

**PROCEDURE TIME**

![Graph showing density and effect size for PROCEDURE TIME]

**CONTRAST VOLUME**

![Graph showing density and effect size for CONTRAST VOLUME]

**BF\(_{10}\) interpretation**

<table>
<thead>
<tr>
<th>Evidence</th>
<th>No difference</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evidence favors the null hypothesis</strong></td>
<td>![Graph showing difference levels for null hypothesis]</td>
<td>![Graph showing difference levels for alternative hypothesis]</td>
</tr>
<tr>
<td><strong>Evidence favors the alternative hypothesis</strong></td>
<td>![Graph showing difference levels for alternative hypothesis]</td>
<td>![Graph showing difference levels for null hypothesis]</td>
</tr>
</tbody>
</table>


**Limitations**

- Publication bias.
- Moderate/high heterogeneity.
- Significant residual heterogeneity.
Conclusions

1. Most data published for radial vs. femoral access in prior CABG patients are observational.

2. Radial access is associated with lower vascular access complication rates and contrast volume in observational studies and higher rates of crossover to femoral access in both observational and randomized studies.

3. Bayesian analysis: Likelihood of difference is weak to moderate.

REBIRTH Trial: Radial vs. State-Of-The-Art Femoral Access for Bleeding and Access Site Complication Reduction in Cardiac Catheterization

60 patients enrolled
It is better to debate a question without settling it than to settle a question without debating it.
- Joseph Joubert

Observed versus Predicted 10-year Cardiovascular Event Rates In A Rural Population-based Health Program: The Heart Of New Ulm Project

Angela Phillips, Abbey Sidebottom, Marc Vacquier, Gretchen Benson, Scott Sharkey, Thomas Knickelbine, Michael D Miedema
Disclosures

• None

Background/Objective

• Background:
  • Estimated 10-year risk for atherosclerotic cardiovascular disease (ASCVD) determined by the Pooled Cohorts Equation (PCE) is an important aspect of the clinician-patient discussion that guides decision making for primary prevention of ASCVD
  • While estimated ASCVD risk is critical to decision-making for primary prevention, the PCE has been shown to be sub-optimally calibrated to many modern populations

• Objective:
  • To evaluate the calibration of the PCE in a modern, rural population participating in a population-based CVD prevention program
Methods

- The study analyzed the difference between the predicted and observed ASCVD event rate of individuals who participated in heart health screening as part of the Heart of New Ulm (HONU) Project (Table 1).
- 10-year ASCVD risk scores were calculated (via the PCE) using data collected at 2009 Heart Health Screening events.
- MI, stroke, and CVD related death from 2010-2019 were collected from electronic health record and state death data.
- Study Population (n=2,819)
  - Individuals 40-79 years of age who lived within the HONU zip code and had adequate data to calculate predicted 10-year risk
  - No ASCVD at baseline

Table 1. Details of the Heart of New Ulm Project (HONU)

- A 10-year population-based health program, aimed at reducing ASCVD risk in the rural population of New Ulm, Minnesota
- The program conducted over 100 baseline screening events and collected survey data on 5,221 individuals in 2009 with follow up screening in 2011 and 2015
- Interventions identified and prioritized through community screening data were delivered through healthcare, worksites, the community, nutrition and built environment
- Interventions with individual registration components engaged 53% of the population age 40-79

Results

Table 2. Baseline demographics of the study population (n= 2,819)

<table>
<thead>
<tr>
<th></th>
<th>Mean or %</th>
<th>(n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years, mean(sd)</td>
<td>56.12 (9.89)</td>
<td></td>
</tr>
<tr>
<td>Gender (female)</td>
<td>59.6%</td>
<td>1681</td>
</tr>
<tr>
<td>Race (white)</td>
<td>99.2%</td>
<td>2,795</td>
</tr>
<tr>
<td>Current smoker</td>
<td>8.1%</td>
<td>227</td>
</tr>
<tr>
<td>Health care coverage (insured)</td>
<td>98.2%</td>
<td>2,754</td>
</tr>
<tr>
<td>Diabetes</td>
<td>6.5%</td>
<td>182</td>
</tr>
<tr>
<td>Hypertension</td>
<td>44.4%</td>
<td>1,251</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>56.6%</td>
<td>1,595</td>
</tr>
</tbody>
</table>
Results

Figure 1. Estimated 10-year ASCVD event rates compared to observed 10-year event rates in a rural sample of men and women participating in a population-based CVD prevention program.

Figure 2. Estimated 10-year ASCVD event rates compared to observed 10-year event rates across all risk categories stratified by gender.
Discussion/Limitation

• In a sample of individuals participating in the HONU screenings, we found that observed ASCVD rates were substantially lower than the rates predicted by the PCE.
• The largest difference was observed in the highest risk category which would carry the greatest influence on medical decision making.
• New Ulm, Minnesota is a relatively homogeneous, predominantly Caucasian population, therefore the results may not be generalizable to more diverse rural populations.
• Minnesota typically has been found to have high rates of access to healthcare as well as high levels of cardiovascular health compared to other states, which may also affect the generalizability of this study.
• While New Ulm has only a single healthcare system, individuals who received healthcare for ASCVD events at facilities outside of New Ulm may not have been captured.

References

Incomplete Revascularization Following Coronary Artery Bypass Grafting (CABG)

Chase Soukup
Christian Schmidt, Carmen Chan-Tram, Ross Garberich, Benjamin Sun MD, Jay Traverse MD

Overview

• Background
• Methods
• Results
• Conclusion
• Acknowledgements
The Rate of Incomplete Revascularization Following Coronary Artery Bypass Grafting (CABG) in 2007 vs 2017 at a Single Institution
COMPLETE REvascularization

- CABG×3
  - LIMA to LAD
  - RSVG to distal RCA
  - RSVG to OM1
Background

- Incomplete Revascularization
  - Up to 50% of patients undergoing CABG
  - 30% increase in long-term mortality
  - 22% increase in myocardial infarction
  - 26% increase in repeat revascularization

Aims

(1) To estimate the rate of incomplete revascularization in patients undergoing CABG in 2007 and 2017 at the Minneapolis Heart Institute at Abbott Northwestern Hospital

(2) Characterize the main reason(s) for incomplete revascularization

Methods

• Two cohorts
  • 2007 vs 2017
  • 581 patients

• Angiograms, Heart Diagrams
  → vessel severity

• CABG Operative Reports
  → arteries bypassed and grafts used
Revascularization Index Score (RIS)

- Major epicardial vessels
  - LAD, OM branch of Cx, and PDA of RCA
    → 1 point if it was revascularized

- Major side branches
  - First Diagonal and Ramus Intermedius
    → >2.0mm diameter and length >50% of LAD length
  - PLB and other Major OM branches
    → >2.0mm diameter

Complete Revascularization

- All major epicardial vessels and their major branch vessels
  - >2.0mm with stenosis >60-70% bypassed
  - Bypassed directly or indirectly via perfusion from a neighbor vessel

- RIS of 1.0
Results

- 2007: 17.9% (52/291)
- 2017: 28.3% (82/290)

Overall

<table>
<thead>
<tr>
<th></th>
<th>Overall n=581</th>
<th>2007 n=291</th>
<th>2017 n=290</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incomplete Revasc (n, %)</td>
<td>134 (23)</td>
<td>52 (17)</td>
<td>82 (28)</td>
<td>0.003</td>
</tr>
<tr>
<td>Age (mean, sd)</td>
<td>67 ± 10</td>
<td>65 ± 11</td>
<td>68 ± 8</td>
<td>0.005</td>
</tr>
<tr>
<td>Males (n, %)</td>
<td>465 (80)</td>
<td>222 (76)</td>
<td>243 (84)</td>
<td>0.024</td>
</tr>
<tr>
<td>Diabetes (n, %)</td>
<td>213 (37)</td>
<td>108 (37)</td>
<td>105 (36)</td>
<td>0.821</td>
</tr>
<tr>
<td>Ever Smoker (n, %)</td>
<td>344 (59)</td>
<td>171 (59)</td>
<td>173 (60)</td>
<td>0.827</td>
</tr>
<tr>
<td>1-year Mortality (n, %)</td>
<td>8 (1)</td>
<td>0 (0)</td>
<td>8 (3)</td>
<td>0.004</td>
</tr>
<tr>
<td>Cardiac Death (1-year) (n, %)</td>
<td>6 (1)</td>
<td>0 (0)</td>
<td>6 (2)</td>
<td>0.015</td>
</tr>
<tr>
<td>Off-Pump (n, %)</td>
<td>103 (18)</td>
<td>67 (23)</td>
<td>36 (12)</td>
<td>0.001</td>
</tr>
<tr>
<td>Cardiopulmonary Bypass Time (min), median (IQR)</td>
<td>72 (45, 91)</td>
<td>71 (0, 91)</td>
<td>73 (51, 91)</td>
<td>0.212</td>
</tr>
<tr>
<td>Previous PCI</td>
<td>144 (25)</td>
<td>65 (22)</td>
<td>79 (27)</td>
<td>0.171</td>
</tr>
</tbody>
</table>
Results

• 2017 Cohort
  • Older \( \rightarrow 65.3 \pm 10.5 \) vs. \( 67.6 \pm 8.4 \) (\( p=0.005 \))
  • More males \( \rightarrow 76.3\% \) vs. \( 83.8\% \) (\( p=0.024 \))
  • No difference in diabetes or smoking

Results

• Off-pump
  • 23.0\% to 12.4\% (\( p=0.01 \))

• 1-year Mortality
  • Total: 0 vs 8 (\( p=0.004 \))
  • Cardiovascular: 0 vs 6 (\( p=0.015 \))
### Incomplete Revascularization

<table>
<thead>
<tr>
<th></th>
<th>Overall n=132</th>
<th>2007 n=52</th>
<th>2017 n=82</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean, sd)</td>
<td>67 ± 9</td>
<td>65 ± 10</td>
<td>68 ± 8</td>
<td>0.098</td>
</tr>
<tr>
<td>Males (n, %)</td>
<td>113 (86)</td>
<td>42 (84)</td>
<td>71 (87)</td>
<td>0.681</td>
</tr>
<tr>
<td>Diabetes (n, %)</td>
<td>50 (38)</td>
<td>19 (38)</td>
<td>31 (38)</td>
<td>0.982</td>
</tr>
<tr>
<td>Ever Smoker (n, %)</td>
<td>77 (58)</td>
<td>27 (54)</td>
<td>50 (61)</td>
<td>0.430</td>
</tr>
<tr>
<td>1-year Mortality (n, %)</td>
<td>3 (2)</td>
<td>0 (0)</td>
<td>3 (4)</td>
<td>0.289</td>
</tr>
<tr>
<td>Cardiac Death (1-year) (n, %)</td>
<td>3 (2)</td>
<td>0 (0)</td>
<td>3 (4)</td>
<td>0.289</td>
</tr>
<tr>
<td>Revascularization Index Score (mean, SD)</td>
<td>0.70 (0.10)</td>
<td>0.73 (0.09)</td>
<td>0.67 (0.11)</td>
<td>0.005</td>
</tr>
<tr>
<td>Off-Pump (n, %)</td>
<td>20 (15)</td>
<td>10 (20)</td>
<td>10 (12)</td>
<td>0.225</td>
</tr>
<tr>
<td>Cardiopulmonary Bypass Time (min), mean ± SD</td>
<td>90 ± 32</td>
<td>79 ± 32</td>
<td>0.376</td>
<td></td>
</tr>
<tr>
<td>Previous PCI, n (%)</td>
<td>30 (23)</td>
<td>8 (16)</td>
<td>22 (27)</td>
<td>0.150</td>
</tr>
<tr>
<td>LIMA graft utilized (%)</td>
<td>88</td>
<td>97</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>LVEF – pre-CABG (%)</td>
<td>51.3 ± 13.7</td>
<td>53.0 ± 13.3</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>LVEF – 1-year post (%)</td>
<td>53.0 ± 11.8</td>
<td>56.9 ± 10.3</td>
<td>0.01</td>
<td></td>
</tr>
</tbody>
</table>

### Results

- Baseline demographics
- RIS
  - 0.73 vs. 0.67 (p=0.005)
Results

- LIMA graft utilized
  - 88% vs 97% (p=0.03)
- LVEF
  - Before CABG (p=ns)
  - Post-CABG 53.0 ± 11.8 vs. 56.9 ± 10.3 (p=0.01)
Conclusion

- Rate and degree of incomplete revascularization has increased
Acknowledgements

• Jay Traverse MD
• Benjamin Sun MD
• Ross Garberich
• Carmen Chan-Tram
• Christian Schmidt
• MHIF Summer Intern Program - Cline and Dianne Hickok

Thank you.

Questions?
Learning and Innovation among Interventional Cardiologists: Insights from an International Survey


a. Minneapolis Heart Institute and Minneapolis Heart Institute Foundation, Minneapolis, MN
b. Baylor College of Medicine, Houston, TX
c. Brigham and Women’s Hospital, Boston, MA

Results

- 437 respondents

Methods

- 36% of respondents indicated that they found it useful to be involved in educational activities.

Equipment

- 47% of respondents indicated that they were interested in learning new technologies.

Baseline characteristics

- Age: 40-50 years
- Gender: Female
- Education level: Master’s degree
- Professional experience: 10-15 years

Innovation

- 20% of respondents indicated that they were interested in learning new technologies.

Equipment

- 47% of respondents indicated that they were interested in learning new technologies.

Literature

- 30% of respondents indicated that they were interested in reading scientific articles.

Conclusions

- 80% of respondents indicated that they were interested in learning new technologies.

Further reading

- HOPE (Hyperensive Optimization and Prevention of Events) Program
- MHIF (Minneapolis Heart Institute Foundation)
- American Heart Association Scientific Sessions

Prezi
Learning and Innovation among Interventional Cardiologists: Insights from an International Survey

Vemmou E (a), Rangan BV (a), Nikolakopoulos I (a), Xenogiannis I (a), Karacsonyi J (a), Garcia S (a), Burke MN (a), Jnied H (b), Croce K (c), Bergmark B (c), Grilakis ES(a)

a. Minneapolis Heart Institute and Minneapolis Heart Institute Foundation, Minneapolis, MN
b. Baylor College of Medicine, Houston, TX
c. Brigham and Women's Hospital, Boston, MA

Baseline characteristics
- Age: 41.94%
- Type of practice:
  - 45.0% private practice
  - 26.3% university program

Definition of Innovation
1. An idea, method, or device  
   a. Novelty
2. The introduction of something new

Methods
- Online survey involving 38 questions distributed via email list to Interventional Cardiologists
- 621 respondents

Vascular access
- Radial access: 45.6% always use it
- Femoral access: 35% always use it

Steps to increase innovation
- Personalizing the evidence
- Keeping up to date
- Learning new techniques

Equipment
- 86% very likely to introduce recently approved equipment in their practice
- 67.6% tried a new coronary guideline and 51.5% tried new equipment for lesion preparation in the past six months

Limitations
- Low completion rate (<10%)
- Possible selection bias
- Response may be affected by the COVID-19 pandemic

Conclusions
- 60% very likely likely to use recently introduced equipment (higher cost commonest cited barrier)
- Radial access in STEMI underutilized
- Keeping up to date: Reading journals, short course attendance

Creating a world without heart and vascular disease

HOPE DISCOVERED HERE™

American Heart Association
Scientific Sessions

56 of 70
Background

**innovation** noun

1. a new idea, method, or device: **NOVELTY**
2. the introduction of something new
**Methods**

- Online survey involving 38 questions distributed via email list to interventional cardiologists

- Reminders
  - April 17th
  - May 18th
Results

Invitations

- 4,080 opened (50.3%)
- 3,869 unopened (47.7%)
- 63 bounced (0.8%)

- 785 clicked through (9.7%)
- 98 opted out (1.2%)

621 respondents
Baseline characteristics

- Men: 91.6%
- Type of practice:
  - 42.5% private practice
  - 35.9% university program

*4% fellows-in-training
- 35.9% university program

72.9% from the US

6.8% from India
Equipment

- 86% very likely/likely to introduce recently approved equipment in their practice

- 47.6% tried a new coronary guidewire and 51.5% tried new equipment for lesion preparation in the past six months.
Reasons behind hesitation to use new equipment

- High cost
- Uncertainty
- Concerns about training
- Logistical hurdles
- Pleased with current equipment
- Other
Vascular access

Radial access
- 42.6% always use it in STEMI

Femoral access
- 32% always use US guidance
- 91% have used a closure device in the last 6 months (Most used devices: Angioseal (80%) and Perclose (79%))
Keeping up to date/ Learning new techniques

Preferred method: reading journals/workshop attendance
The most effective way to learn something new according to survey respondents

- Workshop/ Short Course attendance
- Proctorship
- Reading
- Attendance of scientific meetings
- Youtube
- E-mails with summary of new guidelines/ equipment/ techniques
- Meeting recordings
- Twitter
- Grand Rounds
- Other
Journals that interventional cardiologists read in order to keep up to date

- JACC Cardiovascular Interventions
- JACC
- New England Journal of Medicine
- Catheterization Cardiovascular Interventions
- Circulation
- Circulation Cardiovascular Interventions
- EuroIntervention
- American Journal Of Cardiology
- European Heart Journal
- Journal of Invasive Cardiology
- Lancet
- Journal of Interventional Cardiology
- JAMA Cardiology
- American Heart Journal
- Cardiovascular Revascularization Medicine
- Canadian Journal of Cardiology
- Other
- Coronary Artery Disease
Limitations

- Low completion rate (<10%)
- Possible selection bias
- Responses possibly affected by the COVID-19 pandemic
- Variability in physician perception and practices among physicians working in different healthcare systems
**Conclusions**

- 86% very likely/likely to use recently introduced equipment (high cost most commonly cited barrier)

- Radial access in STEMI underutilized

- Keeping up to date: Reading journals/short course attendance

Thank you!
Learning and Innovation among Interventional Cardiologists: Insights from an International Survey

Vemmos E (a), Rangan BV (a), Nikolopoulos I (a), Xenogiannis I (a), Karacsonyi J (a), Garcia S (a), Burke MN (a), Jnied H (b), Croce K (c), Bergmark B (c), Brilakis ES(a)

a. Minneapolis Heart Institute and Minneapolis Heart Institute Foundation, Minneapolis, MN
b. Baylor College of Medicine, Houston, TX
c. Brigham and Women’s Hospital, Boston, MA

Background

- Innovation: A noun
- Definition of Innovation:
  1. A new idea, method, or device
  2. The introduction of something new

Results

- 8,110 respondents
- 621 respondents

Methods

- Online survey involving 38 questions distributed via email list to interventional cardiologists

Vascular access

- Radial access: 42.6% always use it in STEMI
- Percutaneous: 33% always use US guidance
- 54% have used a wireless device in the last 6 months
- Invasive: Angiogram (80%) and Percuton (7%) (80%)

Baseline characteristics

- Men: 99.4%
- Type of practice:
  - 40.5% private practice
  - 10.5% university program

Equipment

- 86% very likely/likely to introduce recently approved equipment in their practice
- 47.6% tried a new coronary guidewire and 51.5% tried new equipment for lesion preparation in the past six months.

Limitations

- Low completion rate (<10%)
- Positive selection bias
- Responses possibly affected by the COVID-19 pandemic
- Variability in physicians’ perceptions and practices among physicians working in different healthcare systems

Conclusions

- 60% very likely/likely to use recently introduced equipment (high cost, most commonly cited barrier)
- Radial access in STEMI underutilized
- Keeping up to date: Reading journals/short course attendance

Thank you!