Robotic Percutaneous Vascular Intervention

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Where discoveries are delivered.
Disclosures

- Clinical trial/research support: Boston Scientific, Abbott Vascular, Accumetrics, Gilead Pharmaceuticals, Bristol Myers Squib, Sanofi Aventis, Corindus

- Consulting: Gilead Pharmaceuticals, St Jude, Medicines Company, Corindus, Abbott Vascular

- Speakers Bureau: Medtronic, Abbott Vascular
Percutaneous Coronary Intervention Procedure
Largely Unchanged Over the Last 30 Years

- Tremendous advances in interventional devices
- Evolution in pharmacotherapy
- Little change in the actual technique of PCI

First stent procedure 1986
Procedure largely unchanged 2015
Single Use Cassette

Wire

Second Wire

Stent Catheter
Potential value of robotics to PCI

Patient: Safety and Device Precision

• Wire fixation throughout the procedure

• One millimeter device movements

Physician: Occupational Hazard Reduction

• Reduction in radiation exposure

• Ergonomic position during procedures
PRECISE Trial Lesion Characteristics

- Single lesion in single vessel up to 24mm length
- Covered by one stent
- Exclusions: calcified lesions, proximal tortuosity, CTOs, ostial lesion, bifurcation lesion, unprotected left main
- Average length: 12.2±4.8 mm
- Non C lesions: 83.2%

PRECISE: Device and Procedural Success

• Device success (defined as successful advancement and retraction of the PCI devices without conversion to manual operation) = 98.8%

• Procedural success (final <30% residual stenosis in target lesion without MACE at discharge) = 97.6%

Weisz G et al JACC 2013; 61:1596-1600
Precise Measurements

Avoiding geographical miss!

- Unrelated to angiographic view
- Not affected by foreshortening
- Discrete 1mm movement
Interoperator and Intraoperator (In)Accuracy of Stent Selection Based on Visual Estimation

Paul T. Campbell, MD, FSCAI, FACC, Ehtisham Mahmud, MD, FSCAI, FACC, and J. Jeffrey Marshall, MD, FSCAI, FACC

![Graph showing data points and trend lines](image-url)
Invasive Cardiologists Are Exposed to Greater Left Sided Cranial Radiation

The BRAIN Study (Brain Radiation Exposure and Attenuation During Invasive Cardiology Procedures)

Ryan R. Reeves, MD, Lawrence Ang, MD, John Bahadorani, MD, Jesse Naghi, MD, Arturo Dominguez, MD, Vachaspati Palakodeti, MD, Sotirios Tsimikas, MD, Mitul P. Patel, MD, Ehtisham Mahmud, MD
PRECISE: Operator Radiation Exposure

**Procedure Table**

- 20.6 μGy

**Robotic Operators**

- 0.98 μGy

95.2% reduction (p<0.0001)

median radiation exposure to operator

Weisz G et al JACC 2013; 61:1596-1600
Robotic PCI Ergonomically Superior

Robotic PCI at UC San Diego
Robotic Percutaneous Coronary Intervention

Simple lesions → Complex presentation → Complex lesions
Robotic PCI-Left Main Impella: 59 y/o dialysis patient post CABG with all grafts down
Robotic PCI-Left Main Impella: 59 y/o dialysis patient post CABG with all grafts down
Robotic PCI-Left Main Impella: Angioplasty of ostial left circumflex with a 2.5mm balloon
Robotic PCI-Left Main Impella: Angioplasty of distal left main and proximal LAD with a 3.0 balloon
Robotic PCI-Left Main Impella: Angiography after predilation
Robotic PCI-Left Main Impella: Left Main Stent
Robotic PCI-Left Main Impella: Angiography after stenting
Robotic PCI-Left Main Impella: Post-dilation stent
Robotic PCI-Left Main Impella: Final
LV Dysfunction and 3v CAD

A
B
C
D
Impella and Complete Robotic Revascularization
CORA-PCI (Complex Robotic Assisted PCI) Trial

- 75% type C lesions (N=108 cases; 157 lesions)
- radial, CTO, SVG, ostial, left main, bifurcation, Impella supported
- Completely performed robotically: 82%
- Robotic with partial manual: 10%
- Conversion to manual: 8%
- 1 ostial guide catheter dissection of RCA; 6 PPMI
- Most common reason for partial manual: guide catheter support or bifurcation stenting
CORA-PCI Trial: Lesion Complexity and Procedure Time

**Robotic Versus Manual PCI Procedure Time**

<table>
<thead>
<tr>
<th>Complexity</th>
<th>Robotic Time</th>
<th>Manual Time</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Complexity</td>
<td>39:45</td>
<td>28:04</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Intermediate</td>
<td>43:47</td>
<td>40:06</td>
<td>0.53</td>
</tr>
<tr>
<td>High Complexity</td>
<td>56:27</td>
<td>57:37</td>
<td></td>
</tr>
</tbody>
</table>

p=0.83

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Future Directions of Robotic Interventions

First case
Future Directions of Robotic Interventions

First case

Now
Future Directions of Robotic Interventions

First case

RAPID: Robotic-assisted Peripheral Intervention for PAD; Study Chair: Mahmud
Results TCT 2015
RAPID Trial
(Robotic-Assisted Peripheral Intervention for Peripheral Arterial Disease)

- Site: Medizinische Universität Graz
- Design: Prospective, single-arm, single center, non-randomized feasibility study of the CorPath 200 System to examine its performance during interventions of the superficial femoral arteries and patient outcomes through 24 hours post-procedure or hospital discharge, whichever occurs first.
- Primary Outcome Measures:
  - Successful cannulation of the target vessel using the CorPath 200 System.
  - Absence of device-related Serious Adverse Events during the procedure.
- PI – Marianne Brodmann, MD
- Study Chair: Ehtisham Mahmud, MD

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RAPID patient: baseline
RAPID
Robotic manipulation of guidewire and balloon
RAPID patient: final
Conclusions

• Robotic PCI reduces occupational hazard of interventional cardiology
• Robot is a natural extension of an individual’s skills
• Precise positioning of the balloon/stent limit LGM
• Indirect control of guide catheter is possible
• Aggressive guide catheter and supportive guidewire
• Complex PCI and peripheral vascular interventions are feasible with the current generation Corindus robotic platform
• Future: Over-the-wire platform; bifurcation stenting; 0.035 platform