Technical Aspects of Overview in CTO-PCI

Toyohashi Heart Center
Takahiko Suzuki, M.D
Introduction

• CTO-PCI has been technically and technologically evolved over the past two decades; thereby resulted in the expansion of indications.

• In technical perspective, the development of various techniques including parallel wiring, IVUS guided wiring, as well as retrograde wiring technique was introduced.

• In technological perspective, new guidewires were introduced and significantly improved the success rate of CTO-PCIs.

• The advent of the drug-eluting stent has been improved the long-term patency rate.
Objective

The aim of this presentation is to introduce current overview CTO-PCI including the operator technique, equipment, and outcomes.
Devices

CTO wires
Microcatheters
Balloon catheters
1. The superior performance of the device

Current CTO guidewires

Spring coil wire

- Neo’s Miracle® (Getz Brothers)
- Neo’s Conquest (Getz Brothers)
- AthleteGT Magic® (Japan Life Line)
- Zeon CTO wire® (Zeon Medical)

Hydrophilic coated wire

- Wizard (Nihon Lifeline)
- Fielder bros (Asahi Intec)
- X-treme (Asahi Intec)
- Choice PT® (Boston Scientific)
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Neo’s Miracle®
The concepts of the wire

- Thicker Spring Coil
- Thicker Core Wire
- Shorter Length of Spring Coil
- Better Torque
- Greater Strength
- No Wire Trapping

Variations of Stiffness to Match Lesion Characteristics

- **Miracle 3**
  - Stainless Core Wire
  - 0.014” Teflon Coating
  - 110mm Radiopaque Spring Coil

- **ACS HI-TORQUE STD.™**
  - 0.014”
  - 30mm Radiopaque Spring Coil
  - 300mm Spring Coil

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**Spring coil wires**

### Miracle
- **Wire Diameter**: 0.014” / 0.014”
- **Tip Radiopaque**: 11cm Platinum
- **Tip Stiffness**: 3.0, 4.5, 6.0, 12.0g
- **Coating (Dis./ Prox.)**: Silicon / Teflon

### Magic
- **Wire Diameter**: 0.014” / 0.014”
- **Tip Radiopaque**: 2cm Gold Tip
- **Tip Stiffness**: 4.5, 9.0, 18.0g
- **Coating (Dis./ Prox.)**: Hydrophilic / Teflon

### ZEON CTO (NEW!)
- **Wire Diameter**: 0.012” / 0.014”
- **Tip Radiopaque**: 12cm Platinum
- **Tip Stiffness**: 4.5, 9.0, 15.0g
- **Coating (Dis./ Prox.)**: Hydrophilic / Teflon
**X-treme**

**Tip Stiffness 0.8g**  
**Tip Diameter 0.009 ~0.014**

- 16cm Polymer Sleeve & Hydrophilic Coating
- 16cm Radio-opaque spring coil

**Fielder FC**

**Tip Stiffness 0.8g**  
**Tip Diameter 0.014**

- 11cm Spring Coil
- 3cm Radio-opaque Coil

**Fielder**

**Tip Stiffness 1.0g**  
**Tip Diameter 0.014**

- 12cm Spring Coil
- 3cm Radio-opaque Coil
Wizard Basic Information
Specification

<table>
<thead>
<tr>
<th>Model</th>
<th>Tip Stiffness</th>
<th>Radiopaque</th>
<th>Coating</th>
<th>178cm</th>
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<tbody>
<tr>
<td>WIZARD 1</td>
<td>1g</td>
<td>16.5cm</td>
<td>17cm Hydrophilic</td>
<td></td>
</tr>
<tr>
<td>WIZARD 3</td>
<td>3g</td>
<td>16.5cm</td>
<td>17cm Hydrophilic</td>
<td></td>
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</table>
Microcatheters
Microcatheters

Transit 2 (Cordis)
Excelsior (Boston Scientific)
Good Master (Goodman)
Finecross MG (Terumo)
Ichibanyari (Kaneka)
Tornus (Asahi Intec)
Corsair (Asahi Intec)
Micro catheters

Transit 2 (Cordis)

Excelsior (Boston Scientific)
Micro catheters

Good Master (Goodman)

Finecross MG (Terumo)
Micro catheters

Ichibanyari (Kaneka)

Length 1350mm
Tapered 150mm
Sleeve 300mm

0.017" 0.43mm
0.014" 0.35mm

I.D φ0.46
O.D φ0.71

75mm

Tornus (Asahi Intecc)

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Channel Dilator
Corsair
Basic structure is same as Tornus device.
- Tapered Soft Tip
- 20cm Screw Head Structure
- Hydrophilic Polymer Coating
- PTFE Inner Layer
Balloon Catheters
<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Diameter (mm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVATEC</td>
<td>1.00</td>
<td>FALCON</td>
</tr>
<tr>
<td>TERUMO®</td>
<td>1.25</td>
<td>Tazuna</td>
</tr>
<tr>
<td>Medtronic</td>
<td>1.25</td>
<td>Sprinter LEGEND</td>
</tr>
<tr>
<td>GOODMAN</td>
<td>1.3</td>
<td>Lacrosse</td>
</tr>
<tr>
<td>Boston Scientific</td>
<td>1.5</td>
<td>Maverick</td>
</tr>
<tr>
<td>Abbott</td>
<td>1.5</td>
<td>Voyager</td>
</tr>
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</table>
Operator Techniques

Single technique
Parallel wiring technique
IVUS guide wiring technique
Retrograde wiring technique
Development of CTO Techniques

- Single wire
- Parallel wire
- IVUS guided
- Retrograde (CART)

2000 2001 2005

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Parallel Wire
(Contact wire Technique)
Parallel (contact) wire technique is effective when the stiffer guidewire goes into subintima and makes a false lumen.
Case 19 T  70’s. male

Target Lesion: mid LAD (CTO)

Diagnosis: OMI, AP

Prior intervention:

’09.12.15  STENT (ost RCA AMI) Cypher

STENT (prox. RCA) TAXUS

Coronary risk factor:

HT, Current smoking

EuroSCORE: 5

SYNTAX Score: 36

Final CAG findings:  ’09.12.15

LVEF: 46%

CAG: mid LAD 100%, LM 50%,
    prox. LCX 75%, mid LCX 90%,
    prox RCA 90%(AMI)-> 0%(Cypher+TAXUS)
Advanced CTO technique-2

IVUS Guided Wiring
Crossing Technique
How to IVUS Guide Wire Crossing Technique

1. Advance the guidewire into the subintimal space
2. Subintimal space is enlarged with a 1.5mm balloon catheter along with the guidewire
3. IVUS catheter is advanced into the subintimal space. Stiff guidewire is advanced into the true lumen.
4. Wire manipulation under IVUS imaging
Retrograde Technique

Advanced CTO technique-3
Concept of CART™ technique

(Controlled Antegrade and Retrograde subintimal Tracking)

- make connection between antegrade and retrograde subintimal space utilizing behavior of subintimal dissection.
- antegrade wire automatically gets into distal true lumen.
Bilateral Approach for CTO lesion
Retrograde wire usually gets into plaque, not into subintima at proximal part of distal CTO end so that retrograde balloon is inflated at intra-plaque.

If antegrade wire is advanced into subintima at the site of retrograde balloon dilation, it is difficult to direct the antegrade wire to the true distal lumen, similar to a difficult situation in the antegrade approach.
PCI-CTO

Toyohashi Experience

~2009
Doctors in THC
Number of CTO-PCI

N=1136
# Lesion Characteristics

(’99-’09, n=1577)

<table>
<thead>
<tr>
<th>Target vessel</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCA</td>
<td>621</td>
<td>(39.4%)</td>
</tr>
<tr>
<td>LAD</td>
<td>473</td>
<td>(30.1%)</td>
</tr>
<tr>
<td>LCX</td>
<td>334</td>
<td>(21.2%)</td>
</tr>
<tr>
<td>LMT</td>
<td>8</td>
<td>(0.5%)</td>
</tr>
<tr>
<td>Branch</td>
<td>138</td>
<td>(8.8%)</td>
</tr>
<tr>
<td><strong>Bypass graft</strong></td>
<td>2</td>
<td>(0.13%)</td>
</tr>
<tr>
<td><strong>Prior PCI</strong></td>
<td>424</td>
<td>(26.9%)</td>
</tr>
<tr>
<td><strong>In-stent occlusion</strong></td>
<td>171</td>
<td>(10.8%)</td>
</tr>
<tr>
<td><strong>Bending&gt;45°</strong></td>
<td>194</td>
<td>(12.3%)</td>
</tr>
<tr>
<td><strong>Calcified lesion</strong></td>
<td>555</td>
<td>(35.2%)</td>
</tr>
<tr>
<td><strong>Significant side branch</strong></td>
<td>231</td>
<td>(14.6%)</td>
</tr>
</tbody>
</table>
Crossing Guide Wire (2009, n=118)

- Failure: 33%
- Miracle: 33%
- X-treme: 27%
- Others: 3%
- Conquest: 11%
- FielderFC: 15%
- Wizard: 4%
- Pilot: 4%
*Toyohashi experience*

*CTO-PCI ('04 vs. '09)*

**Crossed guide wires**

- **2004 (n=120)**
  - Spring coil floppy wire: 67.5%
  - Plastic jacket wire: 15.0%
  - Spring coil CTO wire: 17.5%

- **2009 (n=114)**
  - Spring coil floppy wire: 45.6%
  - Plastic jacket wire: 47.4%
  - Spring coil CTO wire: 7.0%

**Legend**
- *Spring coil floppy wire*
- *Plastic jacket wire*
- *Spring coil CTO wire*
Crossing Techniques
(2009, n=118)

- Single wire: 59%
- Parallel wire: 11%
- IVUS guide: 7%
- Retrograde: 8%
- CART: 12%
- Failure: 3%

Single wire 59%
Toyohashi experience
CTO-PCI (’04 vs. ’09)

Successful guide wire technique by year

- CART technique
- Retrograde approach
- IVUS guided
- Parallel wire technique
- Single wire technique

2004 (n=120)
- 65%
- 23%
- 11%
- 2%

2009 (n=114)
- 61%
- 12%
- 8%
- 11%
- 8%
Initial Success Rate

86.9% (988/1136)
**Toyohashi experience**

*CTO-PCI ('04 vs. '09)*

**Success rate of guide wire crossing**

- **2004**: 86.3% (120/139)
- **2009**: 96.6% (114/118)

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Complications

Major complications

– Death in hospital 8 (0.5%)
– Emergency CABG 4 (0.3%)
– Q-MI 5 (0.3%)

Minor complications

– Cardiac tamponade 14 (0.9%)
– Aortic dissection 5 (0.3%)
– Acute occlusion 12 (0.8%)
– Subacute occlusion 4 (0.3%)
– Side branch compromise 50 (3.2%)
– Coronary perforation
  • Type-I 145 (9.2%)
  • Type-II 13 (0.8%)
## Angiographic Follow Up

<table>
<thead>
<tr>
<th></th>
<th>BMS era (Jan.'03-Sep.'04)</th>
<th>DES era (Jan.'07-Dec.'08)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No. of CTOs</strong></td>
<td>227</td>
<td>307</td>
</tr>
<tr>
<td><strong>Initial success</strong></td>
<td>183 (80.6%)</td>
<td>279 (90.9%)</td>
</tr>
<tr>
<td><strong>No. of CAG F/U</strong></td>
<td>139 (76.0%)</td>
<td>163 (58.4%)</td>
</tr>
<tr>
<td><strong>No. of restenosis</strong></td>
<td>54 (38.8%)</td>
<td>37 (22.7%)</td>
</tr>
<tr>
<td><strong>No. of reocclusion</strong></td>
<td>23 (16.5%)</td>
<td>12 (7.4%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>77 (55.3%)</td>
<td>49 (30.1%)</td>
</tr>
<tr>
<td><strong>No. of TLR</strong></td>
<td>60 (43.1%)</td>
<td>41 (25.1%)</td>
</tr>
<tr>
<td><strong>Clinical restenosis</strong></td>
<td>29.5%</td>
<td>17.6%</td>
</tr>
<tr>
<td><strong>Clinical TLR</strong></td>
<td>32.8%</td>
<td>14.7%</td>
</tr>
<tr>
<td><strong>Mean F/U period</strong></td>
<td>$7.1 \pm 4.4$ (mos.)</td>
<td>$9.3 \pm 4.9$ (mos.)</td>
</tr>
</tbody>
</table>
Summary

- The success rate of CTO-PCI in Toyohashi Heart Center is very high with low restenosis and reocclusion rates.
- With expert technique as well as appropriate device selections, CTO-PCI is not inferior to CABG.
Summary

• Over the past two decades, CTO-PCI has dramatically evolved in both technical and technological aspects.
• The advent of drug-eluting stents has also improved the long-term patency rate of CTO-PCI.
• Therefore, the role of vascular interventionists further expanded.
CTO Club

The 12th Seminar of Angioplasty of Chronic Total Occlusions

Date: June 11th - 12th, 2010
Venue: Hotel Nikko Toyohashi, Aichi, Japan

Save the Date!!