Perforation Management of the CTO Vessel

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EuroCTOClub Berlin 2019
I do not have any potential conflict of interest to report
PROGRESS CTO Registry: Procedural Complications

<table>
<thead>
<tr>
<th></th>
<th>MACE overall</th>
<th>Death</th>
<th>Acute MI</th>
<th>Pericardial tamponade</th>
<th>Perforation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWE</td>
<td>1.09%</td>
<td>0.36%</td>
<td>0.00%</td>
<td>0.43%</td>
<td>1.16%</td>
</tr>
<tr>
<td>ADR</td>
<td>2.96%</td>
<td>0.87%</td>
<td>1.22%</td>
<td>0.87%</td>
<td>5.22%</td>
</tr>
<tr>
<td>Retrograde</td>
<td>5.61%</td>
<td>1.50%</td>
<td>2.46%</td>
<td>0.96%</td>
<td>7.52%</td>
</tr>
</tbody>
</table>

- AWE = Antegrade Wire Escalation
- ADR = Antegrade Dissection Reentry
- Retrograde

*Presentation Tajti P, SCAI 2018*
Perforation - Classification

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Extraluminal crater without extravasation</td>
<td>8%</td>
</tr>
<tr>
<td>Type II</td>
<td>Pericardial or myocardial blush without contrast jet extravasation</td>
<td>13%</td>
</tr>
<tr>
<td>Type III</td>
<td>Extravasation through frank (&gt;1 mm) perforation</td>
<td>63%</td>
</tr>
<tr>
<td>*Type III cavity spilling (CS)</td>
<td>Perforation into an anatomic cavity, chamber, coronary sinus, etc.</td>
<td></td>
</tr>
</tbody>
</table>

*Sometimes referred to as Type IV

Ellis et al, Circulation 1994;90:2725-30
Harries et al, Eurointervention 2014; 10:646-7
PROGRESS CTO: Perforation Type and Treatment

Danek et al. Am J Cardiol 2017;120:1285-1292
Main vessel perforation: Mechanisms

- Calcified CTO lesion
- Wrong wire course
- Subintimal technique
- Post CABG
Calcified LCX CTO post CABG: Rupture after post-dilatation of DES
After PTFE-covered stent graft (= sandwich after DES)
After 3 months ...
Main vessel perforation: Mechanisms

- Calcified CTO lesion
- Wrong wire course
- Subintimal technique
- Post CABG
CTO of RCA
Externalisation and balloon dilatation
After 1. DES and 2. PTFE covered stent
Main vessel perforation: Mechanisms

- Calcified CTO lesion
- Wrong wire course
- Subintimal technique
- Post CABG
CTO of RCA: ADR with Crossboss

Courtesy of K. Mashayekhi
Perforation with CrossBoss
Retrograde Rescue - CTO

Balloon blockade from antegrade
Guideliner assisted Reverse-CART

Final result
Main vessel perforation: Mechanisms

- Calcified CTO lesion
- Wrong wire course
- Subintimal technique
- Post CABG
CTO of RCA 12 yrs. post (2x) CABG, LVEF 20%

Collateral from LCX to RCA-PLA
Unclear position of both wires

Antegrade wire in distal true lumen
After 2.0mm balloon: extravasation

After DES
After 4 covered stents

5 x Everolimus stents (190mm)
5 x Graftmaster covered stents
Hematoma (H) with compression of left atrium

→ Hemodynamics: PA syst 40 mmHg; CI 2.0 l/min/m²
Echocardiography (TTE)

Day 6

Day 14
Main vessel perforation: How to treat

- Proximal balloon inflation to occlude vessel
- Stabilisation of hemodynamics (i.v. fluids / pressors)
- Angio and echo for localisation and risk estimation
- Pericardiocentesis if hypotension (with fluoroscopic control)
- Reversal of heparin if bleeding persists (remove intracoronary devices, flush guide)

More specific

- Prolonged balloon inflation
- Covered stentgrafts
- Retrograde rescue-PCI
- Emergency operation
Covered stent grafts

Papyrus (Biotronik)  Be-Graft (Bentley Medical)
**Coronary perforation: Balloon-Microcatheter Technique**

Balloon inflated in proximal vessel stops bleeding

Microcatheter underneath balloon:
- tip injection
- wire manipulation
- application of coils, thrombin etc.

(Graph modified from Gasparini GL, Catheter Cardiovasc Interv. 2018)
Ping-pong Technique: Two 6F guiding catheters

Microcatheter underneath balloon for wire manipulation
Perforation of distal branch: Mechanisms

- Perforation with hard CTO wire
- Wire perforation in post CABG patient
CTO of distal RCA (2nd attempt)
ConfianzaPro12 passes into true distal lumen (PLA)
Contrast injection after 2nd DES (no collimation):
Wire perforation distal PL-branch

Now floppy wire in PLA
After DES implantation over side branch and blockade with 1.25mm balloon for 15 min ...
Injection of microspheres via microcatheter

Successful occlusion
Pericardial effusion: Pericardiocentesis 150 ml
Perforation of distal branch: Mechanisms

- Perforation with hard CTO wire
- Wire perforation in post CABG patient
Distal branch perforation in a post CABG patient

PCI of RCA CTO 3 months ago

Readmission for LCX PCI
After LCX stenting and kissing balloon with OM2: myocardial staining
Some hours later cardiogenic shock

Huge myocardial hematoma compressing LCX branches
Distal vessel perforation: How to treat

• Staining, no / minimal pericardial effusion:
  - Finish PCI, then reverse heparin
  - Echo in cath lab and post intervention

• Persistent bleeding, pericardial effusion / tamponade:
  - Embolisation via microcatheter with thrombin / microspheres / fat / coils …
  - Covered stent over origin of branch

• Always treat distal branch perforation in post CABG patients

• General recommendations see above
Microspheres: Polyvinyl alcohol embolisation particles

Application with microcatheter or OTW-balloon (prevent back-flow)
Coils and Microcatheters

Axium – ev3  
Codman Helical Xtrasoft

Finecross 1.8 Fr, Caravel, Corsair

Azur-Terumo,  
Boston Figure 8-18  
VortX Diamon - 18

Progreat 2.4 Fr
Some issues …

• Reversal of heparin in specific situations

• Sandwich [DES – Stentgraft] or [Stentgraft – DES]
  - anti-restenotic ?
  - sealing of stentgraft edges

• Leave it or treat it (perforation Ellis I or II, cavity spilling)

• Post CABG CTOs
  - no ventricular but atrial tamponade
  - increased risk for intramyocardial hematoma?
Some issues …

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