CTO PCI: When & How?

Désobstruction d’occlusion coronaire chronique : Quand et Comment?

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Disclosure Statement of Financial Interest

I currently have, or have had over the last two years, an affiliation or financial interests or interests of any order with a company or I receive compensation or fees or research grants with a commercial company:

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Consulting Fees/Honoraria: BOSTON SCIENTIFIC, CORDIS
CTO: When?

Problems:

- Only 5% of PCI are CTO-PCI (Healthcare systems)
- Indications still too much driven by FEASIBILITY
- ...and not CLINICAL STATUS !!
“God gave us 3 patent coronary arteries, and all has to be done to keep them patent”
Quizz 1: What would you do?

- 69 yo, HBP, DL, Heredity & smoke
- Renal Failure with Clr=30ml/mn
- Shortness of breath since 9 months (montain), no chest pain.
- MIBI scan:
Quizz 1 : What would you do ?

1. PCI
2. CABG
3. Medical Tx

95%
0%
5%

11%
30%
59%
Quizz 2 : What would you do ?

• 79 y.o.
• Dyspnea with e- positive stress test
• EKG : apical Q wave
Quizz 2 : What would you do?

Options:
1. PCI
2. CABG
3. Medical Tx
CTO: When?

Collaterals are Usually not Sufficient to Substantially Reduce Ischemia in CTO

European Heart Journal 2006
Litterature

- **Symptom control**
  - Angina
  - CHF
  - Fatigue

- **Improve LV function**
  - Regional
  - Global

- **Survival**
  - Improved tolerance of AMI
  - Complete revascularization
  - Ischemic Risk
CTO: When? Impact on mortality

Effect of Successful CTO PCI on angina

Effect of Successful CTO PCI on subsequent CABG

Effect of Successful CTO PCI on Mortality

125 pts undergoing CTO PCI
64 (55%) success, Seattle Angina Questionnaire at baseline and 1 month
Successful PCI reduces angina, improves physical capacity and QoL

Grantham et al  Circ Cardiovasc Qual Outcomes 2010;3:284
CTO: When?
Impact on arythmia

- Post-hoc analysis of ICD pts
- 718 implants for 1° prevention
- 162 pts - incomplete revasc of major epicardial vessel
- 44% of 162 due to CTO, 56% non-CTO

CTO group
1yr shock rate: 12%
3yr shock rate: 33%
Mortality: 15%

non-CTO group
1yr shock rate: 7%
3yr shock rate: 15%
Mortality: 4%

Mortality Hazard ratio for CTO = 5.6 (p<0.01)

CTO: When?

STEMI with CTO on non-infarcted-related artery = double jeopardy

Kajstra et al. Am J Cardiol 2012;109:208

Prevalence, predictors and clinical impact of unique and multiple chronic total occlusion in non-infarct-related artery in patients presenting with ST-elevation myocardial infarction.
CTO: When?
Stable Angina:
concept of vulnerable plaque & ischemic risk

with courtesy of C. Thompson
CTO: When?
Impact on mortality

Long-Term Follow-Up of Elective Chronic Total Coronary Occlusion Angioplasty
Analysis From the U.K. Central Cardiac Audit Database

Sudhakar George, MD,* James Cockburn, MD,* Tim C. Clayton, MSc,† Peter Ludman, MD,‡ James Cotton, MD,§ James Spratt, MA,∥ Simon Redwood, MD,# Mark de Belder, MD,¶ Adam de Belder, MD,* Jonathan Hill, MA,** Angela Hoye, MBCsB, PnD,‖ Nick Palmer, MD,¶ Sudhir Rathore, MD,¶ Anthony Gershlick, MB BS,¶ Carlo Di Mario, MD, PnD,## David Hilldick-Smith, MD,* on behalf of the British Cardiovascular Intervention Society and the National Institute for Cardiovascular Outcomes Research

ABSTRACT

BACKGROUND Chronic total occlusion (CTO) is common, being reported in 18% to 30% of patients undergoing coronary angiography. Percutaneous coronary intervention (PCI) is usually performed to relieve anginal symptoms, but data are emerging to suggest that there may also be a mortality benefit.

RESULTS A total of 13,443 patients (78.8% male) had a mean age of 63.5 years and underwent 14,439 CTO procedures. CTO PCI was successful in 10,199 cases (70.6%). During follow-up of 2.65 years (interquartile range: 1.59 to 3.83 years), successful PCI of at least 1 CTO was associated with improved survival (hazard ratio [HR]: 0.72; 95% CI: 0.62 to 0.83; p < 0.001). Complete revascularization was associated with improved survival compared with partial revascularization (HR: 0.70; 95% CI: 0.56 to 0.87; p = 0.002) or failed revascularization (HR: 0.61; 95% CI: 0.50 to 0.74; p < 0.001).

CONCLUSIONS Successful CTO PCI was associated with improved long-term survival. The improvement was greatest in patients when complete revascularization was achieved. The identity of the successfully treated occluded vessel was not associated with differences in outcome. (J Am Coll Cardiol 2014;64:235-43) © 2014 by the American College of Cardiology Foundation.
CTO: When? Impact on mortality

Title
Effectiveness of recanalization of chronic total occlusions: A systematic review and meta-analysis

Authors
Dominique Joyal, MD, FACC, Jonathan Afilalo, MD, and Stéphane Rinfret, MD, SM Quebec, Canada

Background
Chronic total occlusion (CTO) recanalizations remain extremely challenging procedures. With improvements in technology and techniques, success rates for recanalization of CTO continue to improve. However, the clinical benefits of this practice remain unclear. The aim of the study was to determine the effectiveness of CTO recanalization on clinical outcomes.

Methods
We performed a systematic review and meta-analysis of published studies comparing CTO recanalization to medical management. Data were extracted in duplicate and analyzed by a random effects model.

Results
We did not identify any randomized controlled trials or observational studies comparing CTO recanalization to a planned medical management. We did identify 13 observational studies comparing outcomes after successful vs failed CTO recanalization attempt. These studies encompassed 7,288 patients observed over a weighted average follow-up of 6 years. There were 721 (14.3%) deaths of 5,056 patients after successful CTO recanalization compared to 390 deaths (17.5%) of 2,232 patients after failed CTO recanalization [odds ratio (OR) 0.56, 95% CI 0.43-0.72]. Successful recanalization was associated with a significant reduction in subsequent coronary artery bypass graft surgery (CABG) (OR 0.22, 95% CI 0.17-0.27) but not in myocardial infarction (OR 0.74, 95% CI 0.44-1.23) or major adverse cardiac events (OR 0.81, 95% CI 0.55-1.21). In the 6 studies that reported angina status, successful recanalization was associated with a significant reduction in residual/recurrent angina (OR 0.45, 95% CI 0.30-0.67).

Conclusions
In highly selected patients considered for CTO recanalization, successful attempts appear to be associated with an improvement in mortality and with a reduction for the need for CABG as compared to failed recanalization. However, given the observational nature of the reviewed evidence, randomized clinical trials are needed to confirm these findings. (Am Heart J 2010;160:179-87.)
CTO: When? Impact on mortality

CTO PCI of RCA & Mortality:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Patients With ULM and No Residual CTO-RCA (n=522)</th>
<th>Patients With ULM and Residual CTO-RCA (n=46)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause death (absolute number)</td>
<td>68</td>
<td>15</td>
<td>0.003</td>
</tr>
<tr>
<td>1-y, % (n=538)</td>
<td>23.8±0.8</td>
<td>4.3±3.0</td>
<td></td>
</tr>
<tr>
<td>3-y, % (n=477)</td>
<td>7.8±1.2</td>
<td>17.6±5.7</td>
<td></td>
</tr>
<tr>
<td>5-y, % (n=157)</td>
<td>15.1±1.9</td>
<td>30.7±7.3</td>
<td></td>
</tr>
<tr>
<td>Cardiac-death (absolute number)</td>
<td>30</td>
<td>11</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>1-y, % (n=538)</td>
<td>2.3±0.7</td>
<td>4.3±3.0</td>
<td></td>
</tr>
<tr>
<td>3-y, % (n=477)</td>
<td>4.1±0.9</td>
<td>17.6±5.7</td>
<td></td>
</tr>
<tr>
<td>5-y, % (n=157)</td>
<td>6.6±1.2</td>
<td>22.7±6.4</td>
<td></td>
</tr>
<tr>
<td>TLR (absolute number)</td>
<td>120</td>
<td>5</td>
<td>0.048</td>
</tr>
<tr>
<td>1-y, % (n=456)</td>
<td>17.0±1.7</td>
<td>4.4±3.1</td>
<td></td>
</tr>
<tr>
<td>3-y, % (n=382)</td>
<td>21.7±1.8</td>
<td>7.2±4.0</td>
<td></td>
</tr>
<tr>
<td>5-y, % (n=123)</td>
<td>24.6±2.1</td>
<td>11.4±5.6</td>
<td></td>
</tr>
<tr>
<td>3-y MI</td>
<td>2.0±0.1</td>
<td>4.4±3.1</td>
<td>0.709</td>
</tr>
<tr>
<td>3-y cardiac-death+MI, %</td>
<td>4.7±0.9</td>
<td>17.6±5.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>3-y MACE, % (cardiac-death+MI+TLR)</td>
<td>24.2±1.9</td>
<td>24.2±6.4</td>
<td>0.878</td>
</tr>
</tbody>
</table>

Migliorini et al, JACC 2011;58:125–30
CTO: When?
Myocardial Viability

- Cardiac MRI = Gold Standard
- Dobutamine Echo
- Nuclear study
- EKG : Q wave

CTO: When?
Myocardial Viability

Kirschbaum et al, Am J Cardiol 2008;101:179-185
CTO: When?
Impact on mortality

• CTO: is not a minor phenomenon!
• CTO: induce a higher mortality!
• Risk: proportional to the *ischemic* burden!
CTO : Indications
Myocardial Ischemia

Shaw et al, Circulation 2008;117:1283

Courage Nuclear substudy
314 (2287) pts had pre and post randomization MPI
Risk of death/MI stratified by ischaemic burden
PCI reduced ischaemia > OMT
CTO: How?
CTO: When?
Syntax (CTO-subgroup)

Head et al. Eur J Cardiothorac Surg 2012;41:535
In-hospital outcomes of percutaneous coronary intervention in patients with chronic total occlusion: insights from the ERCTO (European Registry of Chronic Total Occlusion) registry.


Source
Department of Internal Medicine and Systemic Disease, Clinical Division of Cardiology, Ferrarotto Hospital, University of Catania, Italy. galassi@virgilio.it

Abstract
AIMS:
In comparison with non-occlusive lesions, percutaneous coronary intervention (PCI) of chronic total occlusions (CTO) represents a greater challenge for the interventionalist, due to lower procedural success rates, relatively higher incidence of procedural complications and the increased rate of restenosis. The European Registry of Chronic Total Occlusion (ERCTO) was created with the goal of evaluating the real impact of CTO PCI in the European context, trying to analyse the rates of procedural success, technical information from the CTO procedures and patient outcome.

METHODS AND RESULTS:
Data collection was carried out in 16 centres across Europe, starting from the beginning of January 2008. In two years of activity, a total of 1,914 patients with 1,983 CTO lesions were consecutively enrolled in the registry. Overall procedural success was achieved in 1,607 lesions (82.9%); anterograde procedures obtained higher procedural success of retrograde ones (83.2% versus 64.5%, p<0.001). Coronary perforation occurred more frequently in patients who underwent retrograde approach (4.7% versus 2.1%, p=0.04). Although no differences were observed in terms of 30-day major adverse cardiac events between anterograde and retrograde treated patients, a trend toward higher periprocedural non-Q-wave myocardial infarction was found in patients in which the retrograde approach was attempted (2.1% versus 1% p=0.08). Moreover, retrograde approach was related with longer procedural and fluoroscopy times (156.9±62.5 min vs. 98.2±52.8 min and 73.3±59.9 min vs. 38.2±43.9 min respectively, p<0.001) and higher contrast load administration (402±161 cc vs. 302±184 cc, p<0.001).

CONCLUSIONS:
The first report of the ERCTO registry by the EuroCTO club shows a high procedural success rate obtained by expert European operators in a "real-world" consecutive series of patients, comparable with those reported by Japanese registries. The rate of observed procedural adverse events was low and similar to the non-CTO PCI series. In this registry, retrograde procedures were associated with extended fluoroscopy exposure and procedural time, increased contrast load administration as well as a higher incidence of coronary perforations. Such outcomes should become the standard of care that all centres undertaking CTO PCI should aspire to.
Abstract

BACKGROUND:
Percutaneous coronary intervention (PCI) for chronic total occlusion (CTO) is challenging and has been associated with low success rates. However, recent advancements in equipment and the flexibility to switch between multiple technical approaches during the same procedure ("hybrid" percutaneous algorithm) have dramatically increased the success of CTO-PCI. We sought to compare the contemporary procedural outcomes of hybrid CTO-PCI with previously published CTO-PCI studies.

METHODS:
The procedural outcomes of 497 consecutive CTO-PCIs performed between January 2012 and August 2013 at five high-volume centers in the United States were compared with the pooled success and complication rates reported in 39 prior CTO-PCI series that included ≥100 patients and were published after 2000.

RESULTS:
The baseline clinical and angiographic characteristics of the study patients were comparable to those of previous studies. Technical and procedural success was achieved in 455 cases (91.5%) and 451 cases (90.7%), respectively, and were significantly higher than the pooled technical and procedural success rates from prior studies (76.5%, P<.001 and 75.2%, P=.001, respectively). Major procedural complications occurred in 9/497 patients (1.8%) overall and included death (2 patients), acute myocardial infarction (5 patients), repeat target vessel PCI (1 patient), and tamponade requiring pericardiocentesis (2 patients). The incidence of major complications was similar to that of prior studies (pooled rate 2.0%; P=.72).

CONCLUSION:
Use of the hybrid approach to CTO-PCI is associated with higher success and similar complication rates compared to prior studies, supporting its expanded use for treating these challenging lesions.
CTO: How?

The Hybrid Algorithm
Dual Catheter Angiography

1. Clear proximal cap or ambiguity can be solved
2. Good Distal Target
3. Interventionnal colleral
4. Length < 20mm

Antegrade

- Wire escalation
- Dissection Reentry (Crossboss-Stingray)

Retrograde

- Wire escalation
- Dissection Reentry (reverse CART)

**Angiographic Success and Procedural Complications in Patients Undergoing Percutaneous Coronary Chronic Total Occlusion Interventions**

A Weighted Meta-Analysis of 18,061 Patients From 65 Studies

Vishal G. Patel, MD,* Kimberly M. Brayton, MD, JD,* Aracely Tamayo, MSW, MPH,†
Owen Mogabgab, MD,* Tesfaldet T. Michael, MD, MPH,* Nathan Lo, MD,*
Mohammed Alomar, MD,* Deborah Shorrock,* Daisha Cipher, PtD,*
Shuaib Abdullah, MD,* Subhash Banerjee, MD,* Emmanouil S. Brilakis, MD, PtD*

CTO : How?
Technical Success + Safety

High operator’s CTO PCI associated with

• Improved success

• without increase of complications

(/PCI)

Procedural outcomes of chronic total occlusion percutaneous coronary intervention: a report from the NCDR (National Cardiovascular Data Registry).
JACC Cardiovasc Interv. 2015 Feb;8(2):245-53
CTO: How?

Correlation between center and operator volumes and patient outcomes

EXPERIENCE

= SUCCESSS
# CTO: How?

## Multivariate logistic regression analysis associated with technical failure

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, per 10-yr increase</td>
<td>1.19</td>
<td>1.04-1.36</td>
<td>0.01</td>
</tr>
<tr>
<td>Men</td>
<td>0.70</td>
<td>0.47-1.05</td>
<td>0.08</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.16</td>
<td>0.86-1.55</td>
<td>0.33</td>
</tr>
<tr>
<td>Ejection fraction &lt;35%</td>
<td>0.89</td>
<td>0.50-1.58</td>
<td>0.68</td>
</tr>
<tr>
<td>History of MI, %</td>
<td>0.91</td>
<td>0.68-1.21</td>
<td>0.50</td>
</tr>
<tr>
<td>History of CABG, %</td>
<td>1.22</td>
<td>0.86-1.74</td>
<td>0.26</td>
</tr>
<tr>
<td>Prior PCI, %</td>
<td>0.98</td>
<td>0.74-1.29</td>
<td>0.87</td>
</tr>
<tr>
<td>Occlusion duration &lt;12 months</td>
<td>0.95</td>
<td>0.80-1.12</td>
<td>0.55</td>
</tr>
<tr>
<td>Occlusion length &lt; 20 mm</td>
<td>1.00</td>
<td>0.82-1.34</td>
<td>0.99</td>
</tr>
<tr>
<td>Experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50 versus &gt;100</td>
<td>3.07</td>
<td>2.19-4.30</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>50-100 versus &gt;100</td>
<td>2.17</td>
<td>1.52-3.10</td>
<td></td>
</tr>
<tr>
<td>J-CTO Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate versus very difficult</td>
<td>0.44</td>
<td>0.25-0.77</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Medium difficult versus very difficult</td>
<td>0.42</td>
<td>0.28-0.62</td>
<td></td>
</tr>
<tr>
<td>Quite difficult versus very difficult</td>
<td>0.61</td>
<td>0.44-0.85</td>
<td></td>
</tr>
</tbody>
</table>

Dr Galassi, EuroCTO club Registry Data  
NY CTO Summit 2014
CTO: How?

Comparison of Success Rate
High volume center vs. Low volume center

Dr Tsuchikane, Japanese Retrograde Summit data
NY CTO Summit 2014
## CTO: How?

### 2014 ESC/EACTS Guidelines on myocardial revascularization

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>It should be considered that trainees in cardiac surgery perform at least 200 CABG procedures under supervision before being independent.</td>
<td>IIA</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>CABG should be performed with an annual institutional volume of at least 200 CABG cases.</td>
<td>IIA</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Routine use of the internal mammary artery at a rate &gt;90% is recommended.</td>
<td>I</td>
<td>B</td>
<td>162,924</td>
</tr>
<tr>
<td>Routine reporting of CABG outcome data to national registries and/or the EACTS database is recommended.</td>
<td>I</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Physicians training in interventional cardiology should complete formal training according to a 1–2 year curriculum at institutions with at least 800 PCIs per year and an established 24-hour/7-day service for the treatment of patients with ACS.</td>
<td>IIA</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Physicians training in interventional cardiology should have performed at least 200 PCI procedures as first or only operator with one-third of PCI procedures in emergency or ACS patients under supervision before becoming independent.</td>
<td>IIA</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>National Societies of the ESC should develop recommendations on annual operator and institutional PCI volume. This Task Force recommends the operator and hospital volumes listed below:</td>
<td>IIA</td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

- PCI for ACS should be performed by trained operators with an annual volume of at least 75 procedures at institutions performing at least 400 PCI per year with an established 24-hour/7-day service for the treatment of patients with ACS.
- PCI for SCAD should be performed by trained operators with an annual volume of at least 75 procedures at institutions performing at least 200 PCI per year.
- Institutions with an annual volume of fewer than 400 PCI should consider collaboration in networks with high-volume institutions (more than 400 PCI per year), with shared written protocols and exchange of operators and support staff.

Non-emergency high-risk PCI procedures, such as distal LM disease, complex bifurcation stenosis, single remaining patent coronary artery, and complex chronic total occlusions, should be performed by adequately experienced operators at centres that have access to circulatory support and intensive care treatment, and preferentially have cardiovascular surgery on-site.
Aptitude à l’exercice du cathétérisme diagnostique et interventionnel

Seuls les cardiologues dont les compétences en hémodynamique, coronarographie et angioplastie sont reconnues peuvent réaliser des cathétérismes diagnostiques et interventionnels. Les cardiologues hémodynamiciens, coronarographistes et angioplasticiens doivent exercer leur art régulièrement, sans discontinuité, au point d’en faire leur activité prépondérante. Pour maintenir cette compétence, ils doivent avoir une pratique suffisante, dont la quantité et la qualité sont certifiées par la tenue d’une banque de données. Ils ont le devoir de suivre régulièrement un programme de formation post-universitaire régulièrement évalué.

L’élaboration de ce document a respecté la démarche habituelle adoptée par la Société française de cardiologie. Dans un premier temps, elle a nommé un groupe d’experts chargé de rédiger un texte prenant en compte les travaux scientifiques les plus récents. Lorsque, sur certains sujets, les données manquaient ou s’avéraient inexistantes, voire contradictoires, l’opinion exprimée s’est fondée sur le plus large consensus recueilli au sein du comité de rédaction. Le texte a ensuite été discuté et amendé par un comité de rédaction puis par le comité d’éthique et le conseil d’administration de la Société française de cardiologie qui l’a finalement approuvé.

Ces recommandations feront l’objet de réactualisations, si de nouvelles données scientifiques ou techniques le nécessitent.

Situation actuelle de la France

L’enquête du « Groupe Angiographie et cardiologie interventionnelle » de la Société française de cardiologie sur l’activité des centres de cathétérisme français en 1998 a recensé 210 centres de cathétérisme cardiaque dont...
CTO: How?
CTO: How?

- Success Rates
- Radiation
- Contrast
- Complications

Time
CTO: How? Training

What is limiting the adoption of CTO PCI?

- **Confidence:**
  - Fear of failure
  - Lack of planning
  - Post-case analysis

- **Complexity:**
  - Poor success rates
  - Procedure time
  - Complication rates

- **Confusion:**
  - Inconsistency of teaching
  - Clinical justification

Vinoda et al. presented @ SCAI 2013
CTO : How?
Training

- Prospective, non-randomized registry on CTO PCI
- 4 European countries, 17 dedicated CTO-centers
- 1200 patients
- November 13 - August 15
- Validation of “The Hybrid algorithm”

Dens J, Genk (BE)
Kayaert P, Brussels (BE)
Walsh S, Belfast (UK)
Hanratty C, Belfast (UK)
Spratt J, Edinburgh (UK)
McEntegart M, Glasgow (UK)
Kelly P, Basildon (UK)
Smith D, Swansea (UK)
Smith E, London (UK)
Irving J, Dundee (UK)
Bagnall A, Newcastle (UK)
Smith W, Nottingham (UK)
Strange J, Bristol (UK)
Agostoni P, Utrecht (NL)
Knaapen P, Amsterdam (NL)
Faurie B, Grenoble (FR)
Avran A, Marseille (FR)
Bressollette E, Nantes (FR)
CTO: How?
Training

Procedural success

- 98% Success, Easy
- 96% Success, Inter
- 88% Success, Diff
- 78% Success, V-Diff
- 86% Success, Total

86% Procedure-wise
89% Patient-wise
CTO: How? Training

### Procedural characteristics

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Success</th>
<th>Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>N° of inclusions</td>
<td>1229</td>
<td>1063</td>
<td>166</td>
</tr>
<tr>
<td>Radial access only (%)</td>
<td>25</td>
<td>25</td>
<td>24</td>
</tr>
<tr>
<td>Dual injection (%)</td>
<td>77</td>
<td>76</td>
<td>85</td>
</tr>
<tr>
<td>Procedural success (%)</td>
<td>86</td>
<td>86</td>
<td>-</td>
</tr>
<tr>
<td>Procedure time (min)</td>
<td>104 ± 72</td>
<td>95 ± 66</td>
<td>137 ± 104</td>
</tr>
<tr>
<td>Fluoroscopy time (min)</td>
<td>44 ± 57</td>
<td>40 ± 53</td>
<td>61 ± 24</td>
</tr>
<tr>
<td>Patient AK dose (Gray)</td>
<td>2.1 ± 1.6</td>
<td>1.9 ± 1.4</td>
<td>3.2 ± 2.0</td>
</tr>
<tr>
<td>Contrast volume (ml)</td>
<td>275 ± 135</td>
<td>265 ± 127</td>
<td>340 ± 162</td>
</tr>
</tbody>
</table>
CTO: Conclusion

When?

1. CTO definition is ANATOMICAL!

...but

2. Decision to Open CTO must be FONCTIONNAL!
CTO : Conclusion
When & How?

1. Need for Revascularization : ISCHEMIA / VIABILITY (quantification)

2. Mode of Revascularization : ANATOMY (Syntax score I & II)

3. Open CTO !
CTO: Conclusion

How?

1. In expert centers, modern technics (Hybrid) Success rate CTO PCI > 85%

2. Successful CTO PCI =
   - Symptoms
   - Arythmia
   - CABG
   - Severity future MACE
   - Mortality?
CTO: Conclusion
When & How?

Dr Jean Pellet

Médecine et Humanisme: le grand écart

Quatre siècles de folles histoires médicales
Préface de Pierre Péju

Pellet J. Editions Yves Michel. May 2013
CTO PCI: Why? Who?

Thank You!

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