

Comparing CTO Algorithms – Moving Towards a Global Consensus



WELLINGTON
CARDIOLOGY



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Disclosure Statement of Financial Interest

Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

Affiliation/Financial Relationship

- Grant/Research Support
- Consulting Fees/Honoraria

Company

- Asahi Intecc
- Abbott Vascular, Boston Scientific, Asahi Intecc, Teleflex Medical

Algorithm's to guide PCI

What's the purpose of algorithms?

- Roadmap for decision making
- Standardize and promote best practice
- Serve as a reference for teaching
- Provide a platform for discussion



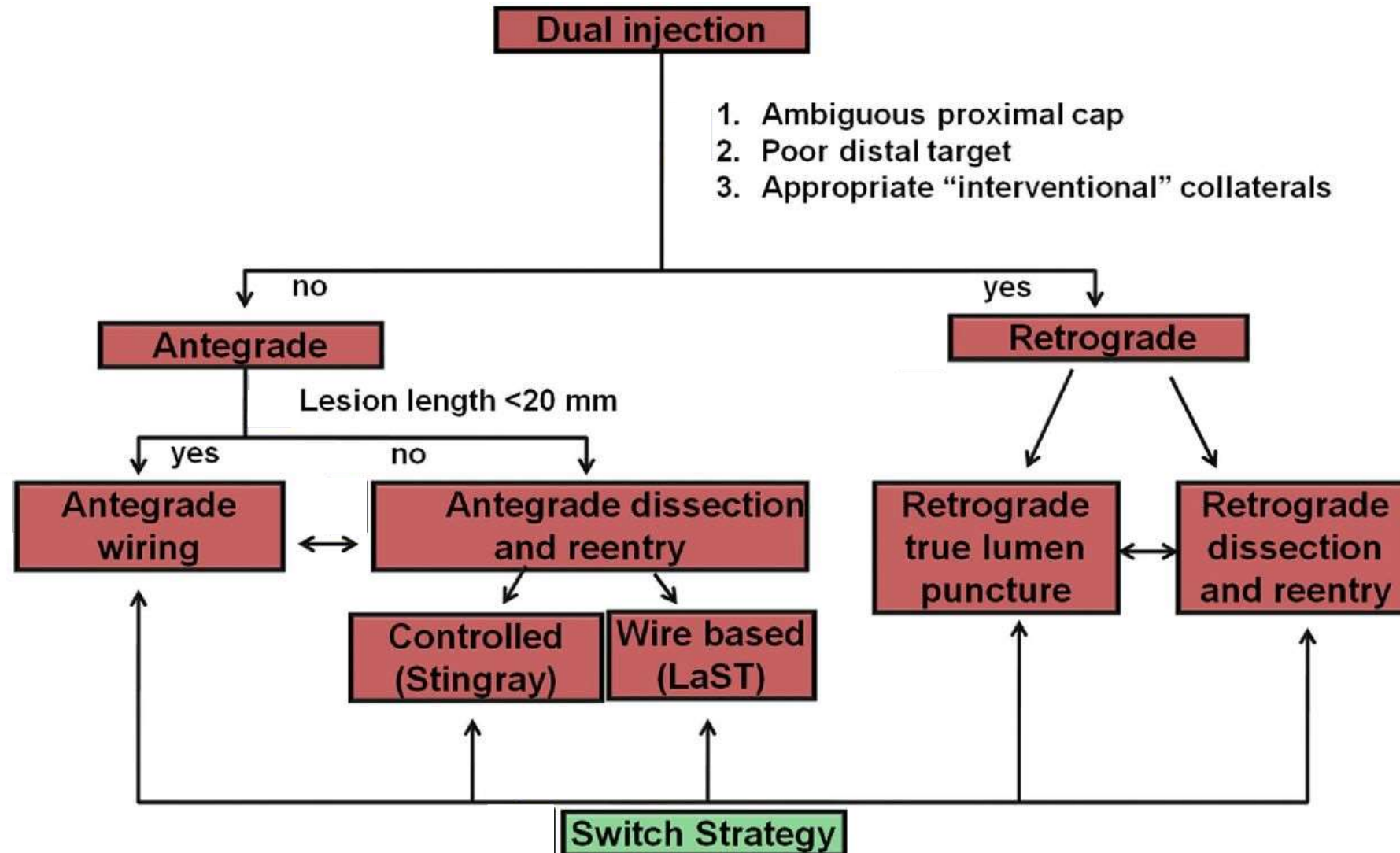
Question: which outcomes are most important?

- Success
- Safety
- Efficiency
- Cost
- Durability

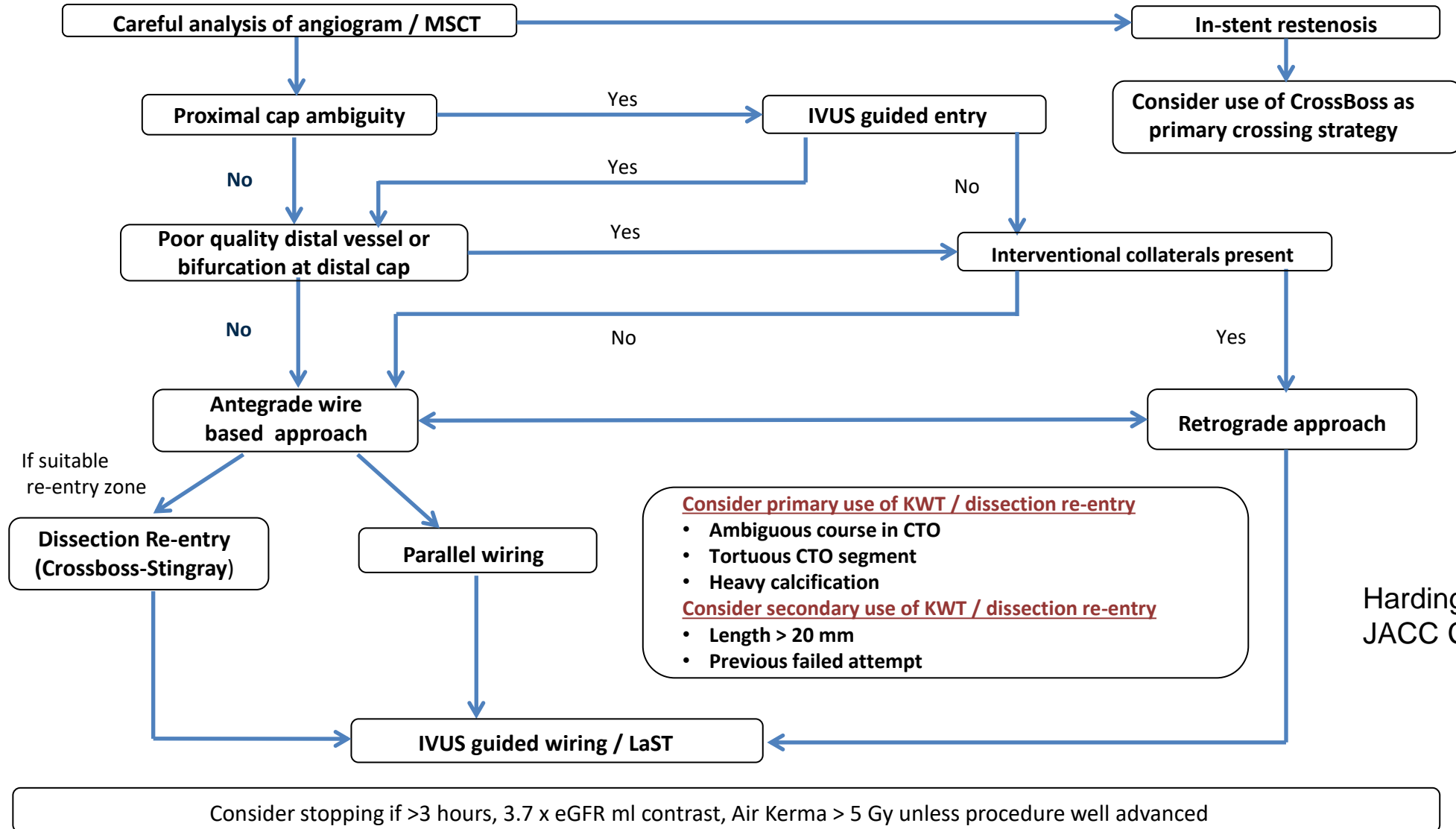
Question: Who are we writing algorithms for?

1. Experts
2. Intermediate operators
3. Beginners

The Hybrid Algorithm



APCTO Algorithm



Consider primary use of KWT / dissection re-entry

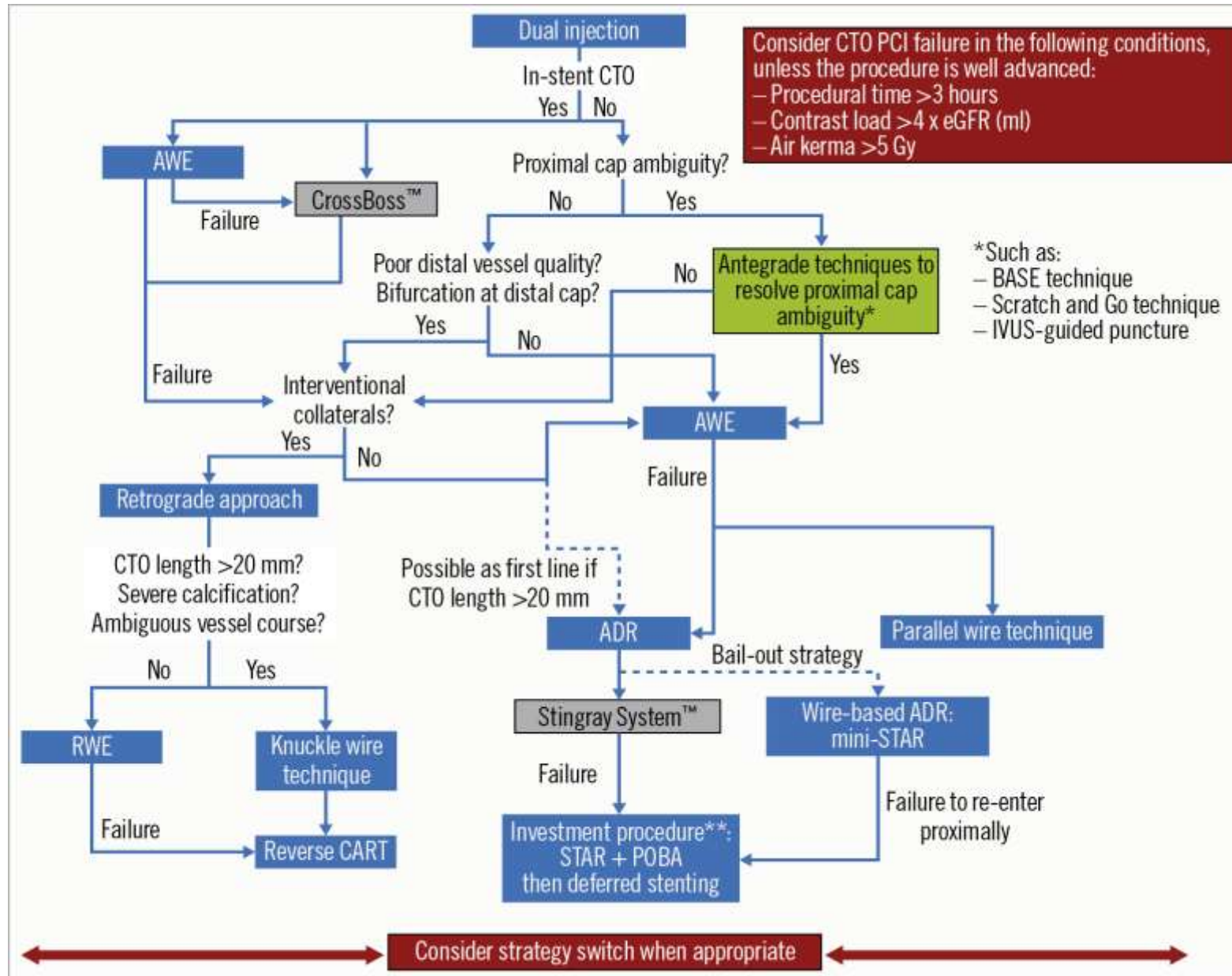
- Ambiguous course in CTO
- Tortuous CTO segment
- Heavy calcification

Consider secondary use of KWT / dissection re-entry

- Length > 20 mm
- Previous failed attempt

Harding S, et al.
JACC CV Interv 2017

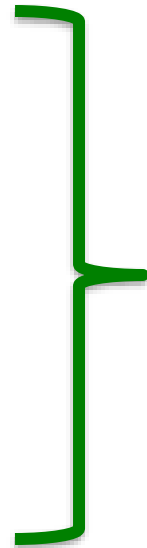
EuroCTO Club Algorithm



Similarities

In all 3 algorithms the same 3 angiographic questions determine initial direction:

1. Proximal Cap Anatomy
 - Defined or Ambiguous?
2. Distal Target
 - Favorable for wiring or re-entry?
3. Collaterals
 - Useable or not?



Antegrade or retrograde

Differences in Algorithms

Initial approach (wire escalation vs. dissection re-entry)
determined by:

Hybrid Algorithm

Occlusion length alone
<20mm = wire escalation
≥20mm = dissection
re-entry

APCTO Algorithm

Consider primary use of dissection re-entry

- Ambiguous course in CTO
- Tortuous CTO segment
- Heavy calcification

Consider secondary use of dissection re-entry

- Length > 20 mm
- Previous failed attempt

EuroCTO Algorithm

Antegrade
No additional criteria

Retrograde
Lesion length >20 mm
Calcification
Ambiguity of CTO course

Differences in Algorithms

Essentially this means that the APCTO and EuroCTO algorithms promote an antegrade wiring approach first in the majority of cases

PROspective Global REgiStry for the Study of CTO interventions



Application and outcomes of a hybrid approach to chronic total occlusion percutaneous coronary intervention in a contemporary multicenter US registry☆

Georgios Christopoulos^a, Dimitri Karpaliotis^b, Khaldoon Alaswad^c, Robert W. Yeh^{d,m}, Farouc A. Jaffer^e, R. Michael Wyman^e, William L. Lombardi^f, Rohan V. Menon^a, J. Aaron Grantham^g, David E. Kandzari^h, Nicholas Lembo^h, Jeffrey W. Moses^b, Ajay J. Kirtane^b, Manish Parikh^b, Philip Green^b, Matthew Finn^b, Santiago Garcia^{i,n}, Anthony Doing^j, Mitul Patel^{k,o}, John Bahadorani^{k,o}, Muhammad Nauman J. Tarar^a, Georgios E. Christakopoulos^a, Craig A. Thompson^l, Subhash Banerjee^a, Emmanouil S. Brilakis^{a,*}

Lesion Length was ≥ 20 mm in 75%

AWE was the primary strategy in 66%

Intravascular Healing Is Not Affected by Approaches in Contemporary CTO PCI

The CONSISTENT CTO Study

Simon J. Walsh, MD,^a Colm G. Hanratty, MD,^a Margaret McEntegart, MD,^b Julian W. Strange, MD,^c Johannes Rigger, MD,^a Peter A. Henriksen, MD,^d Elliot J. Smith, MD,^e Simon J. Wilson, MD,^a Jonathan M. Hill, MD,^f Zlatko Mehmedbegovic, MD,^g Bernard Chevalier, MD,^h Marie-Claude Morice, MD,^h James C. Spratt, MDⁱ

- **Primary CTO approach was AWE in 60%**
- Mean lesion length 29.1 ± 20.4 mm with 66% > 20 mm
- The final approach was AWE in 34%, retrograde wire escalation in 18%, ADR in 18%, and retrograde dissection re-entry in 30%
- 2 strategies were used in 41.4% of patients and 3 strategies in 9.1%

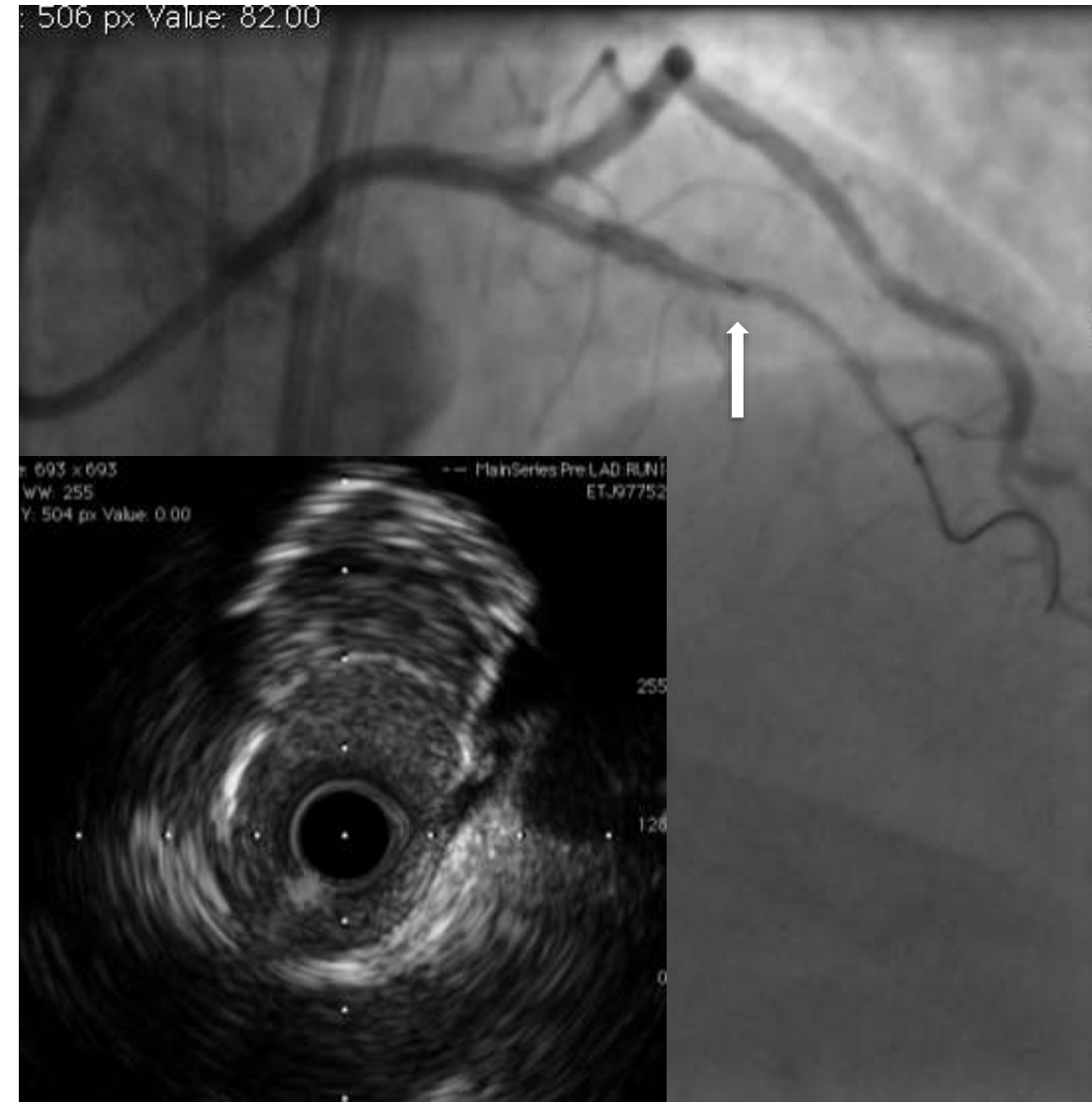
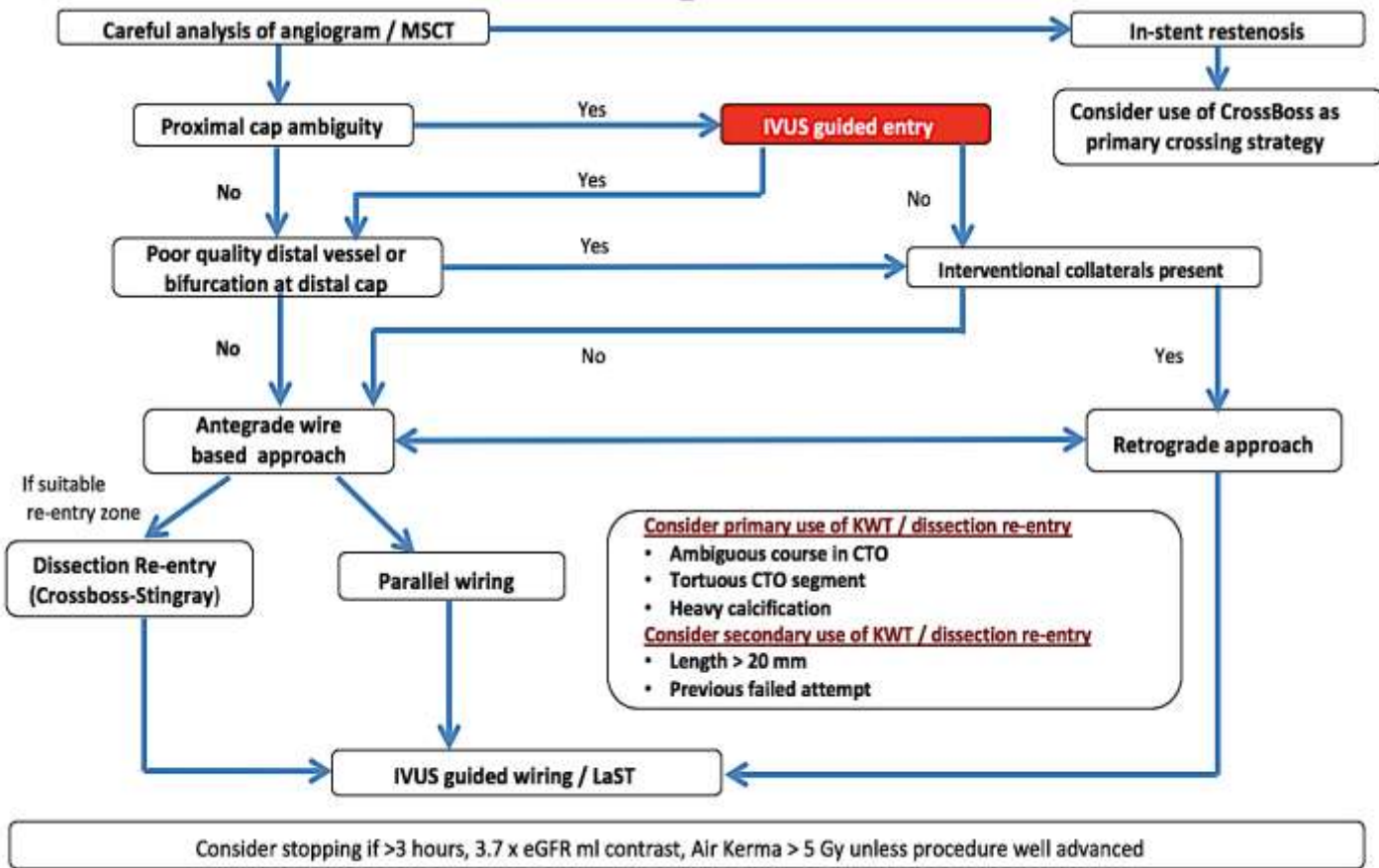
Intravascular Healing Is Not Affected by Approaches in Contemporary CTO PCI

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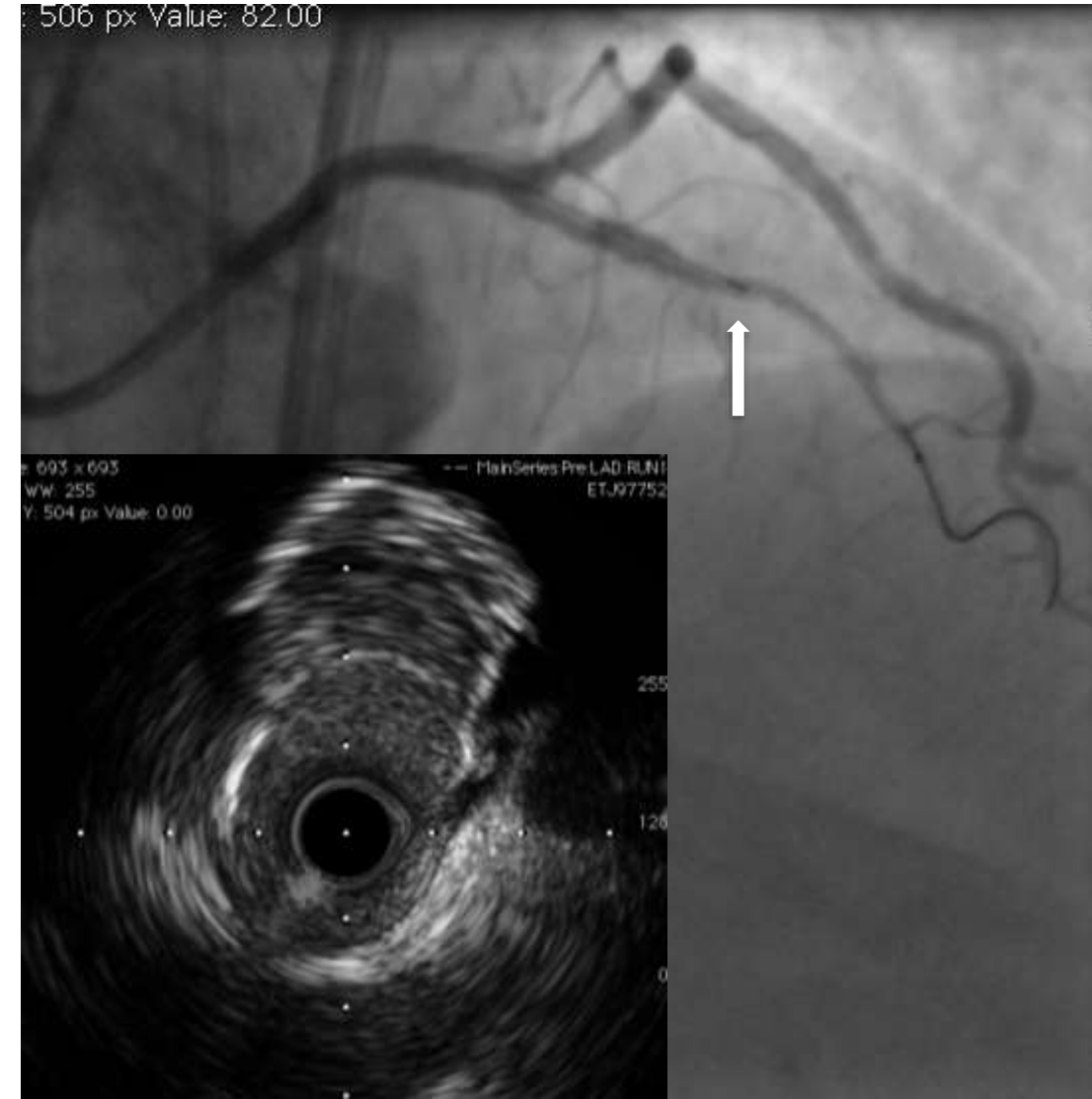
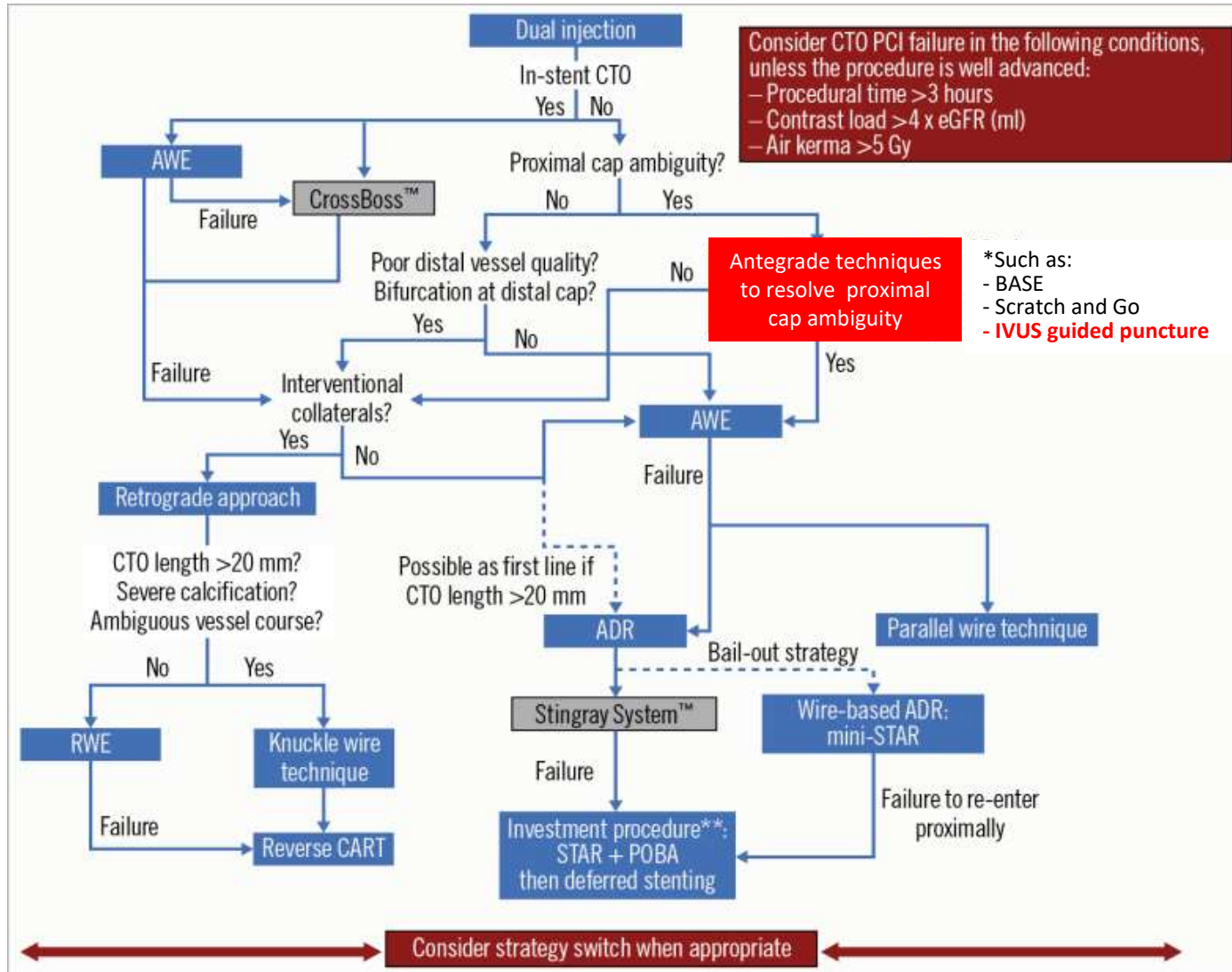
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- Technical success rates 98.6%
- Mean duration 122 (54.2) min
- Pericardiocentesis 1%
- CV mortality 0%
- TVF at 12 months 5.24%.

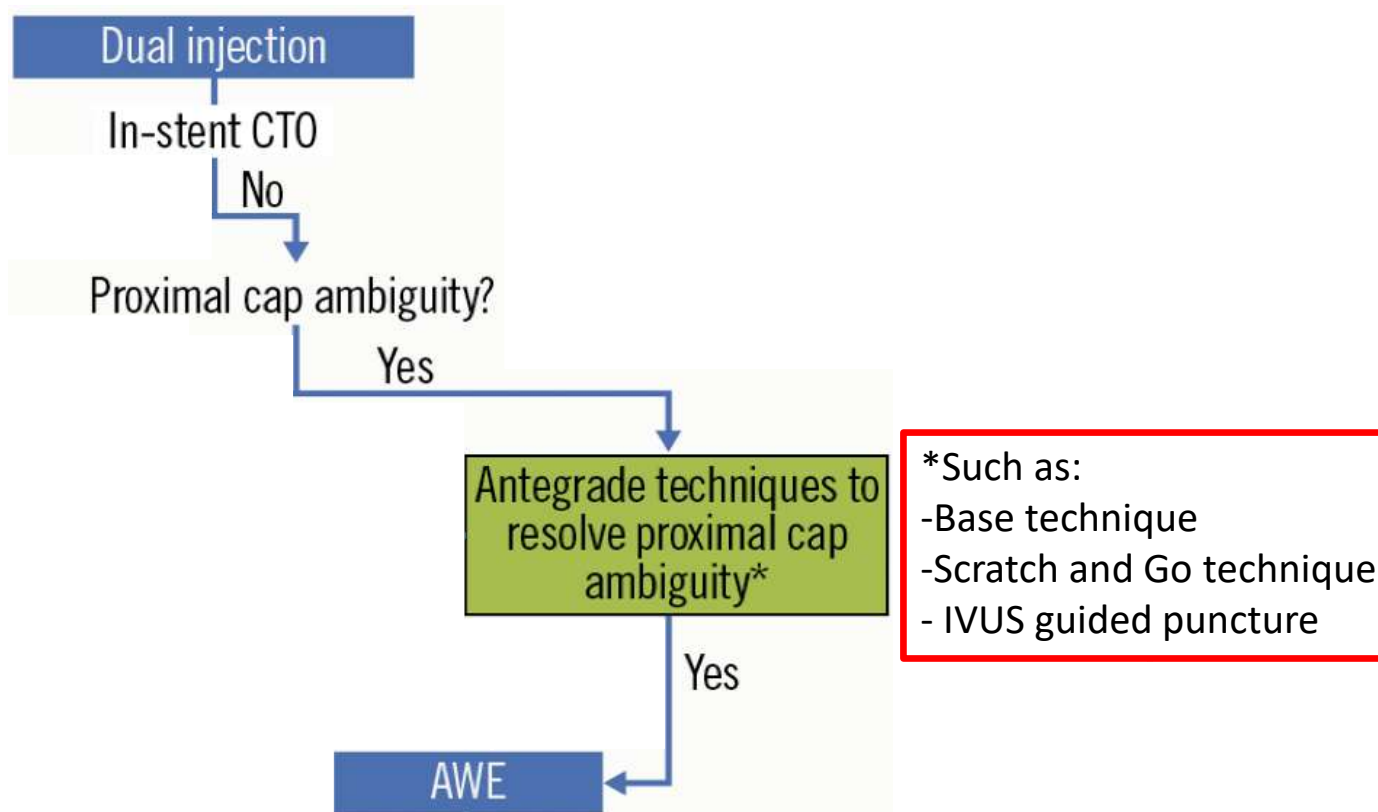
Differences in Algorithms: IVUS guided entry



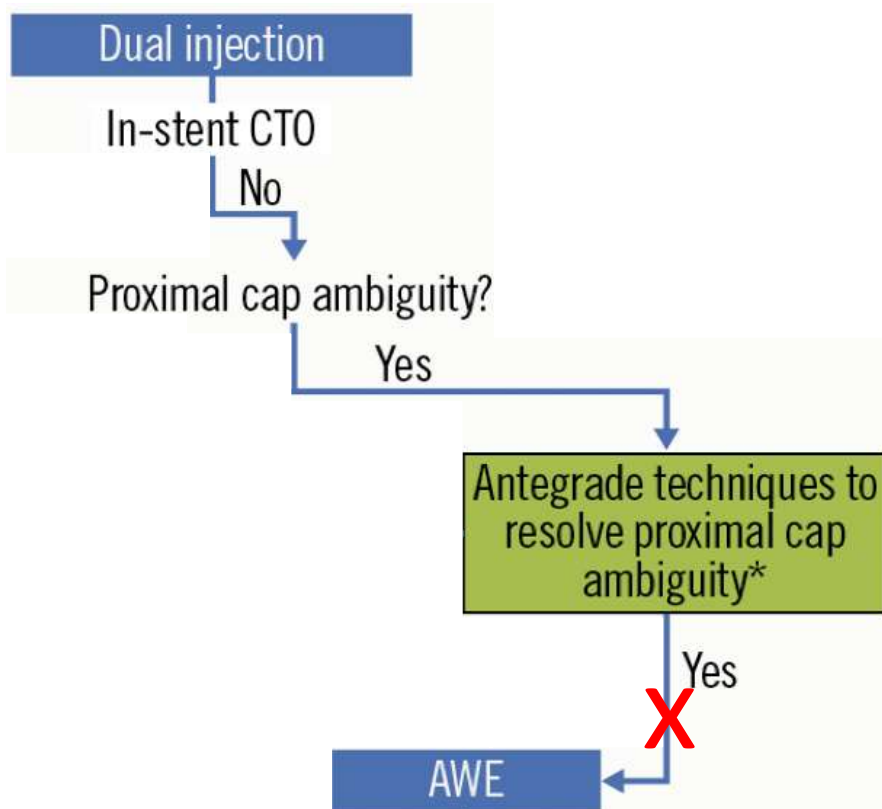
Differences in Algorithms: IVUS guided entry



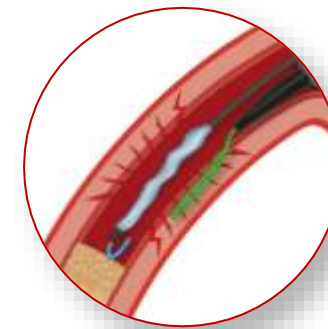
EuroCTO Algorithm



EuroCTO Algorithm: Move the cap

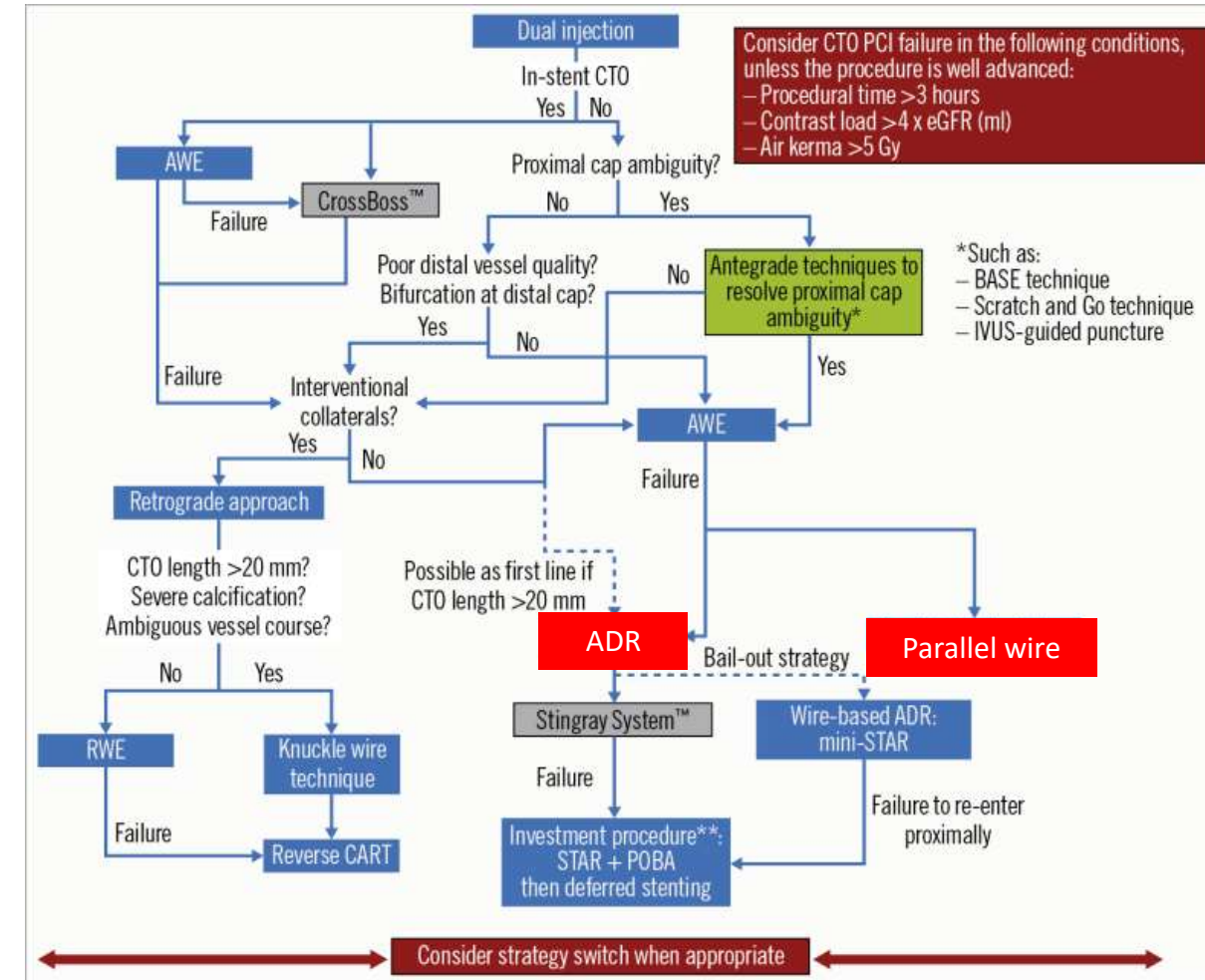
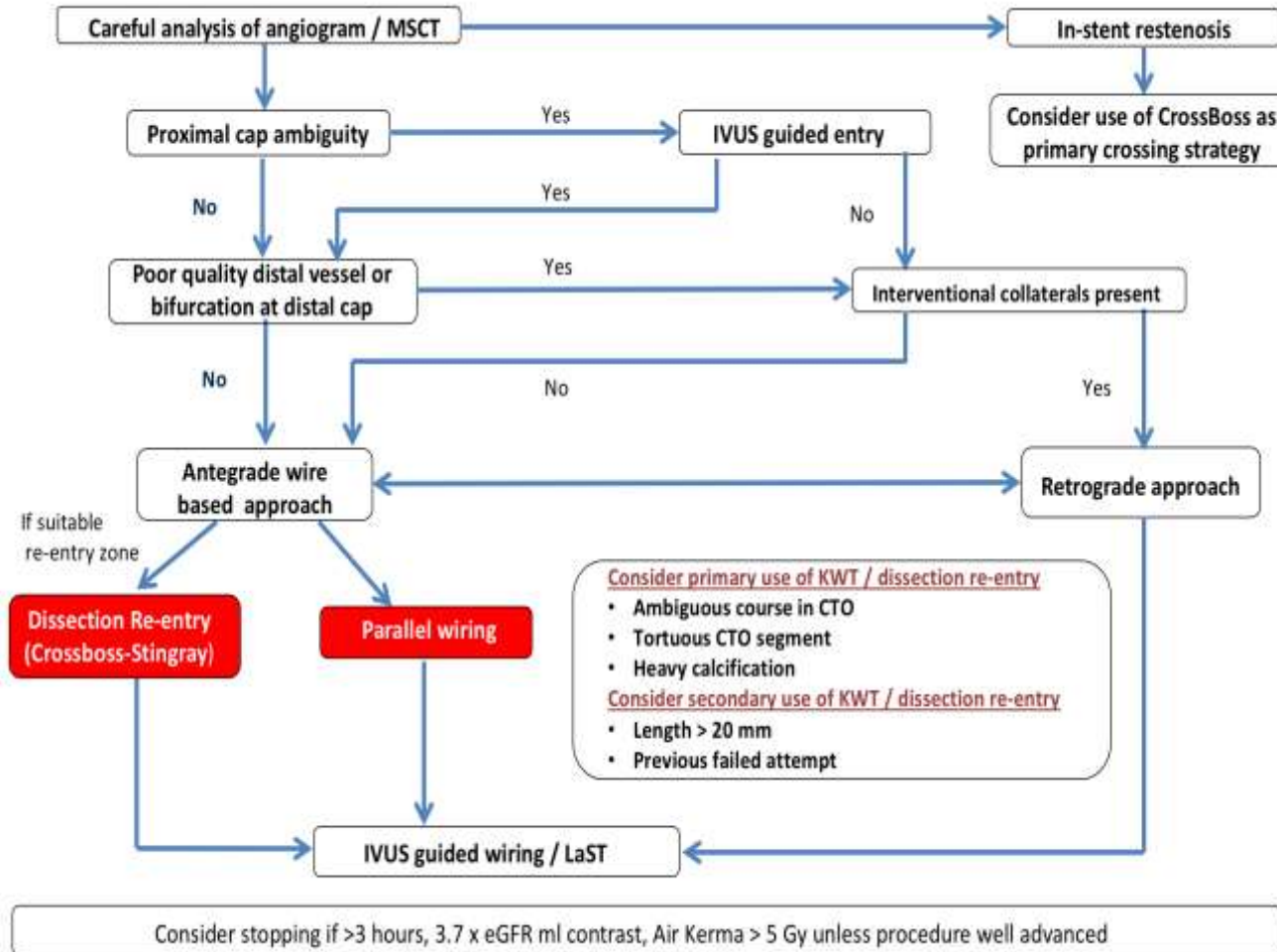


*Such as:
- **Base technique**
- **Scratch and Go**
- IVUS guided puncture

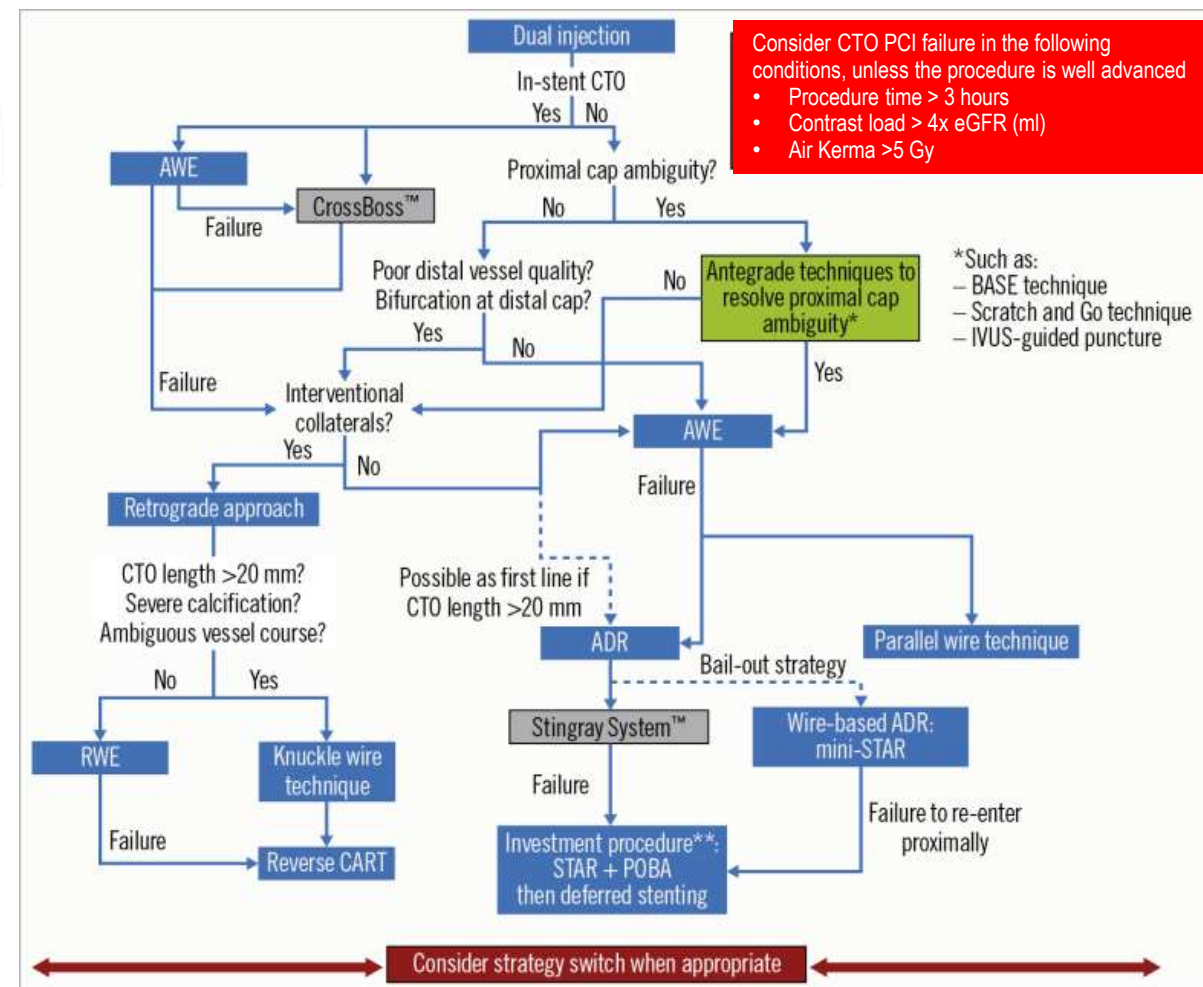
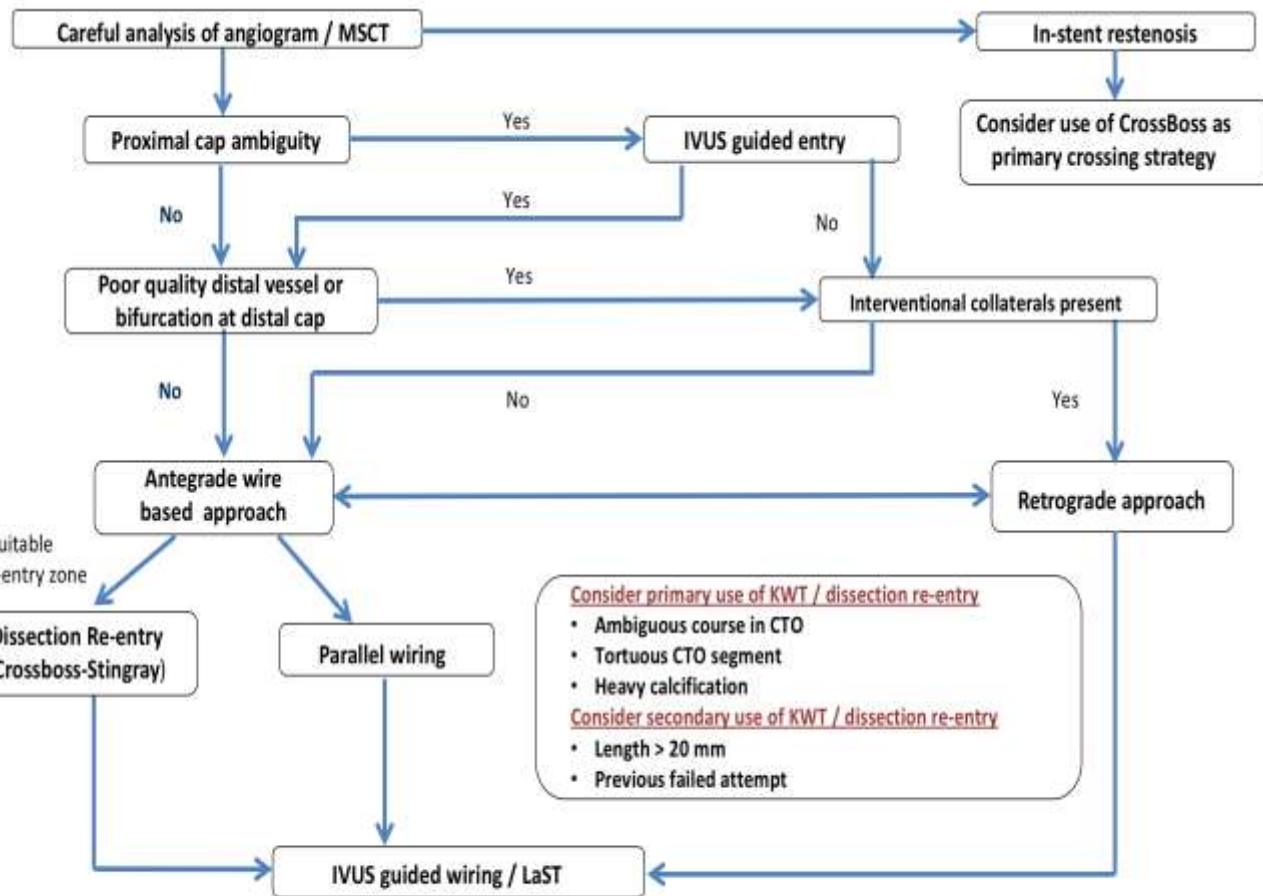


These techniques result in entry of the wire into the subintimal space and preclude use of AWE

Differences in Algorithms – Parallel wire



Differences in Algorithms – when to stop



Consider CTO PCI failure in the following conditions, unless the procedure is well advanced

- Procedure time > 3 hours
- Contrast load > 4x eGFR (ml)
- Air Kerma > 5 Gy

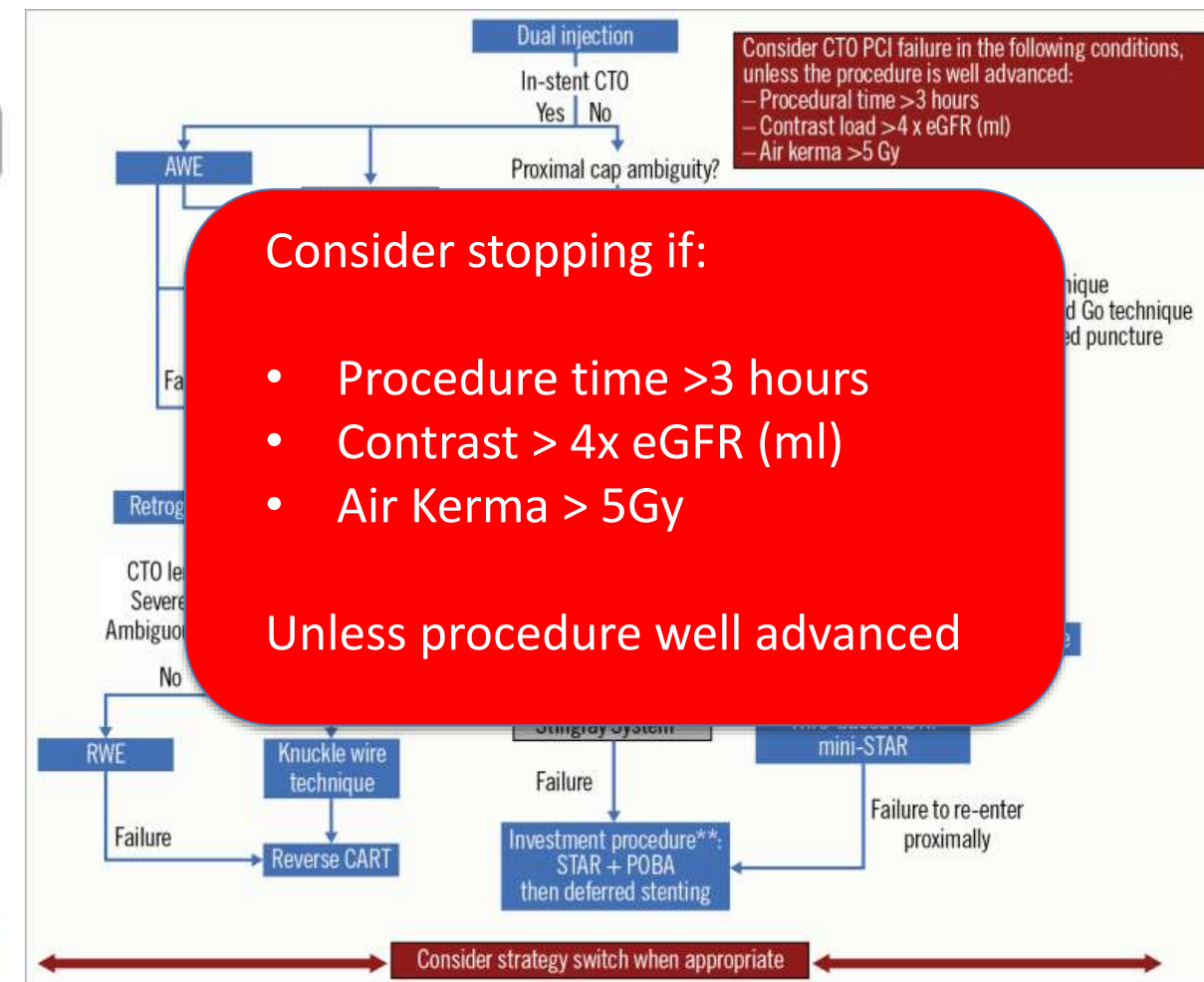
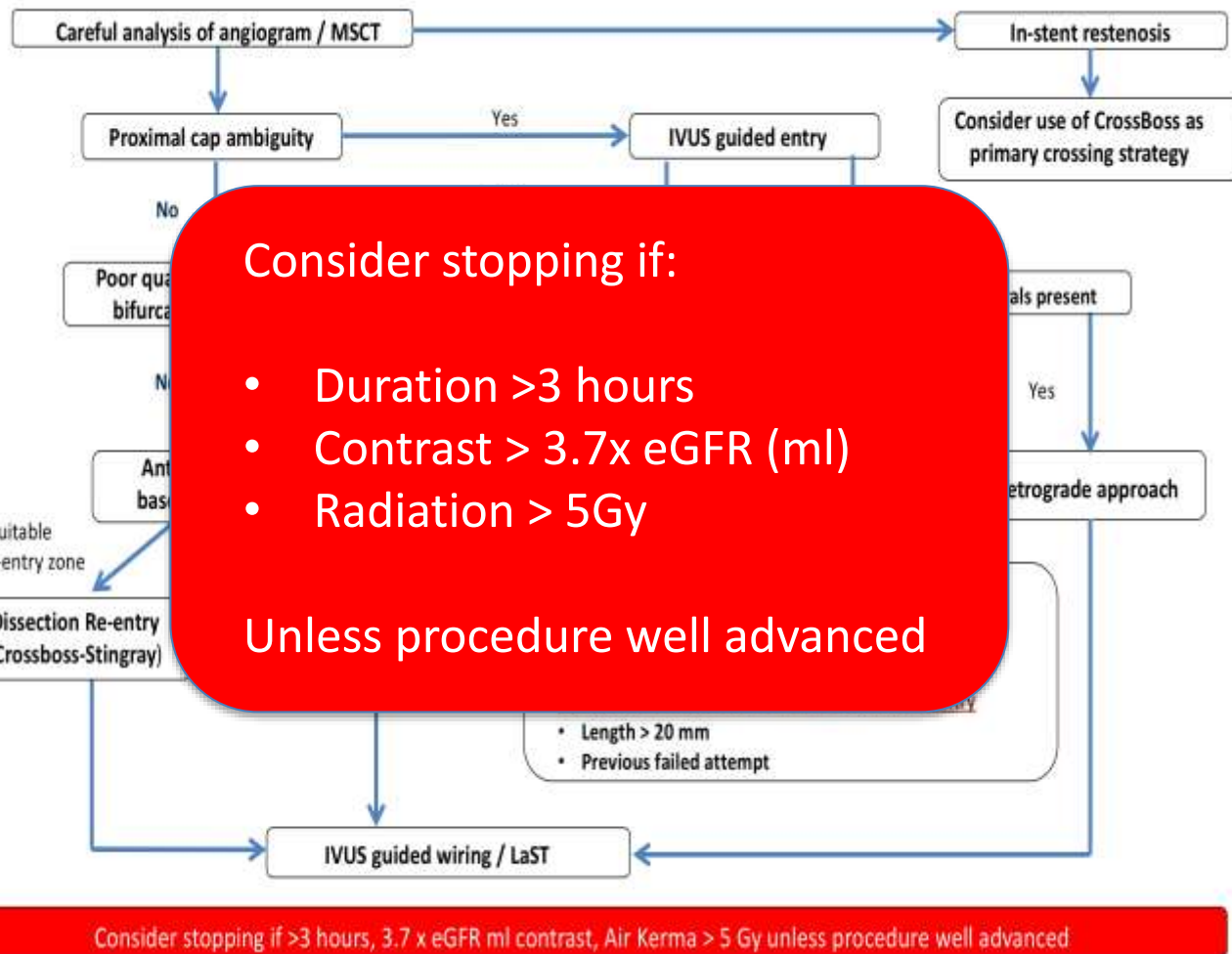
*Such as:

- BASE technique
- Scratch and Go technique
- IVUS-guided puncture

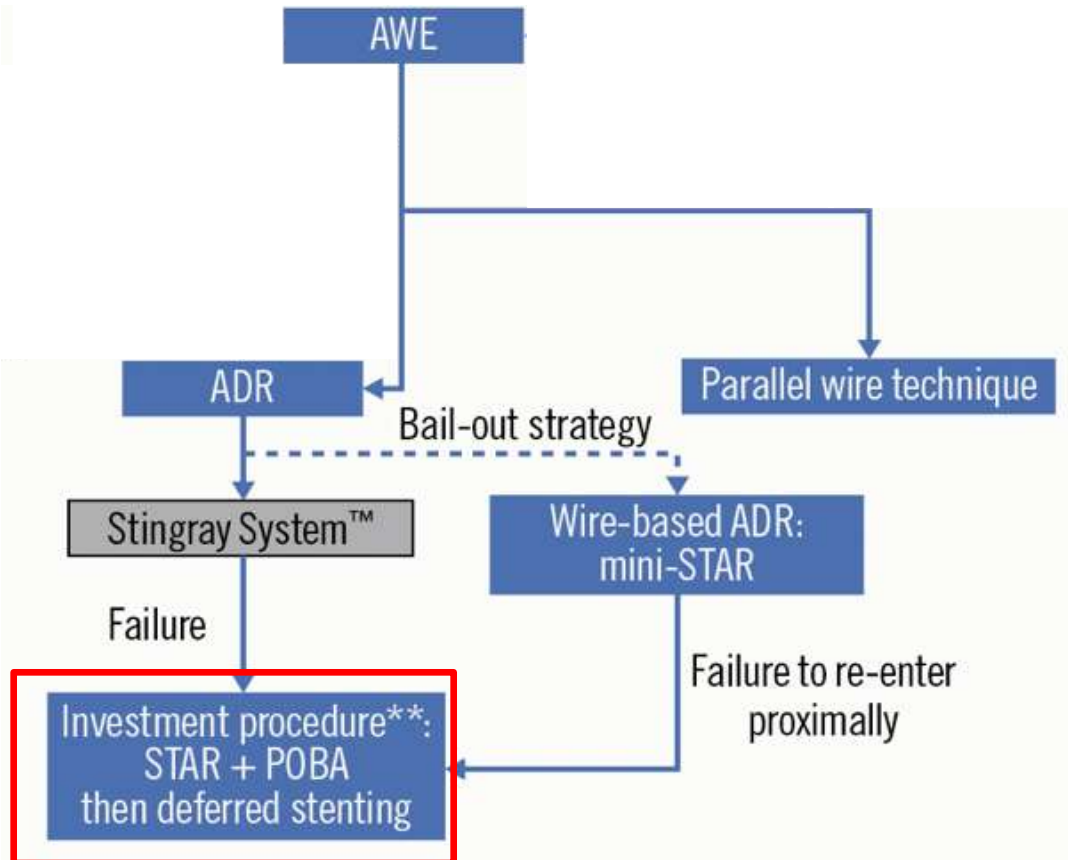
Consider stopping if >3 hours, 3.7 x eGFR ml contrast, Air Kerma > 5 Gy unless procedure well advanced

Consider strategy switch when appropriate

Differences in Algorithms – when to stop

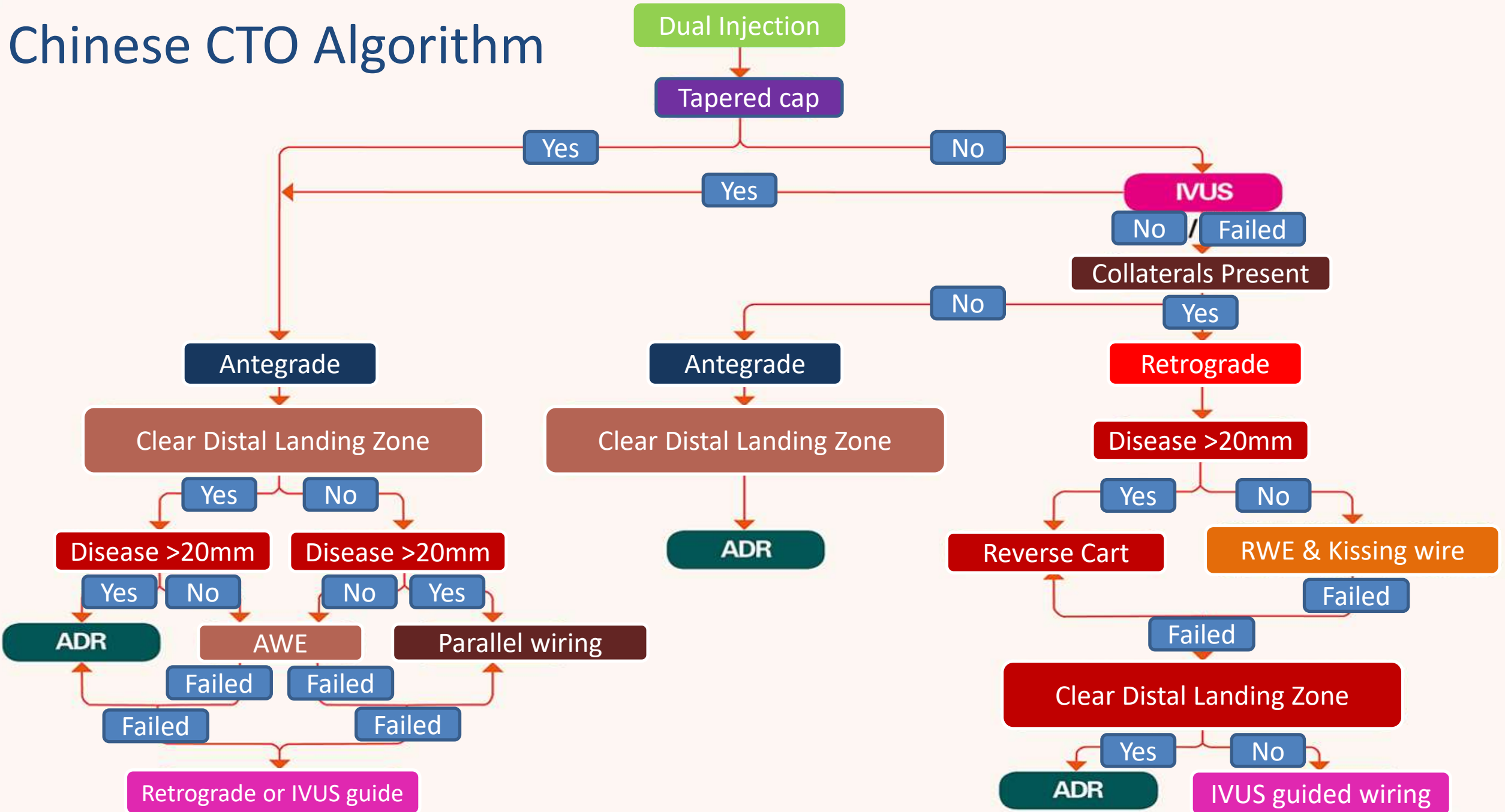


Euro CTO Algorithm



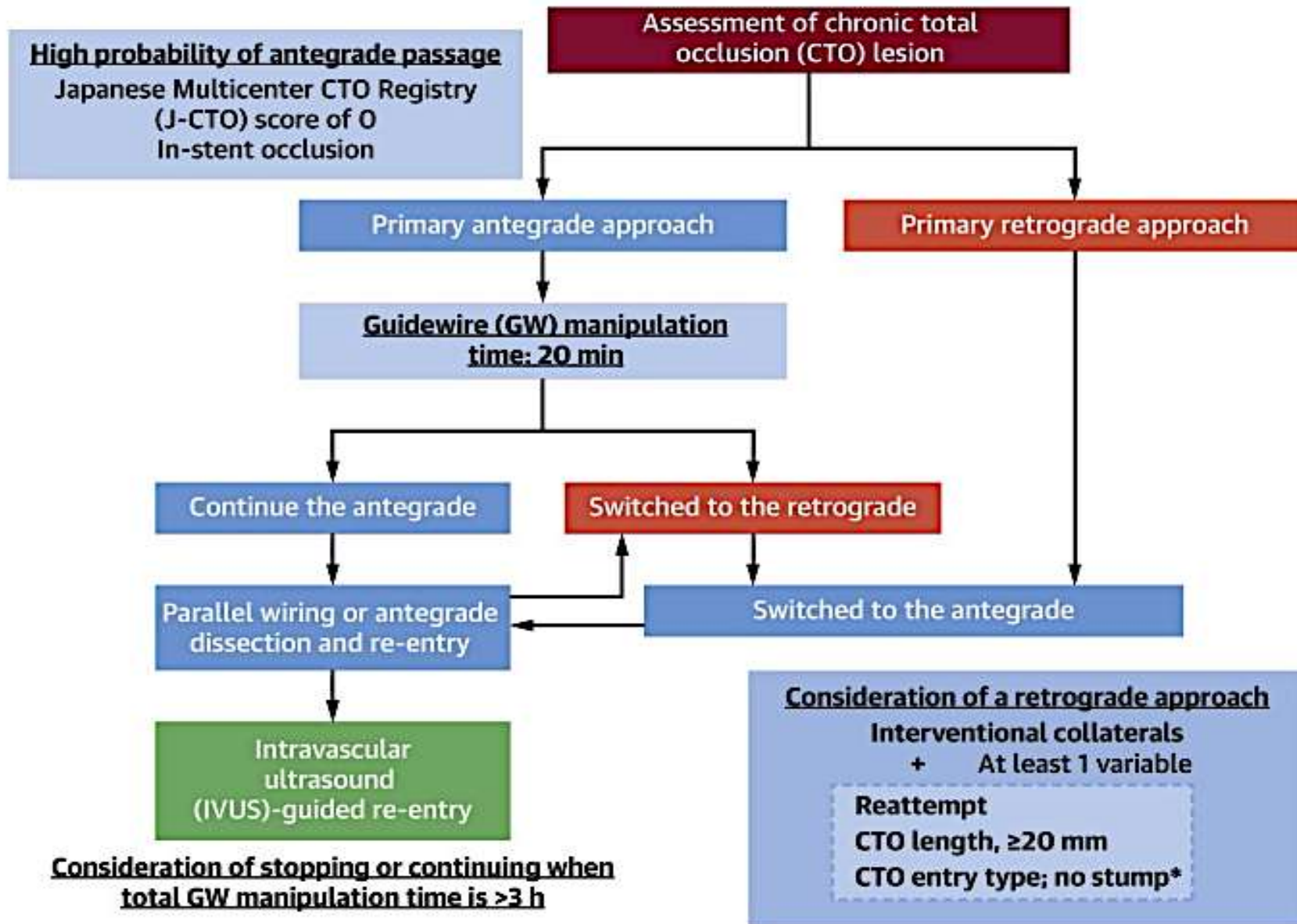
Introduced the concept of an investment procedure

Chinese CTO Algorithm

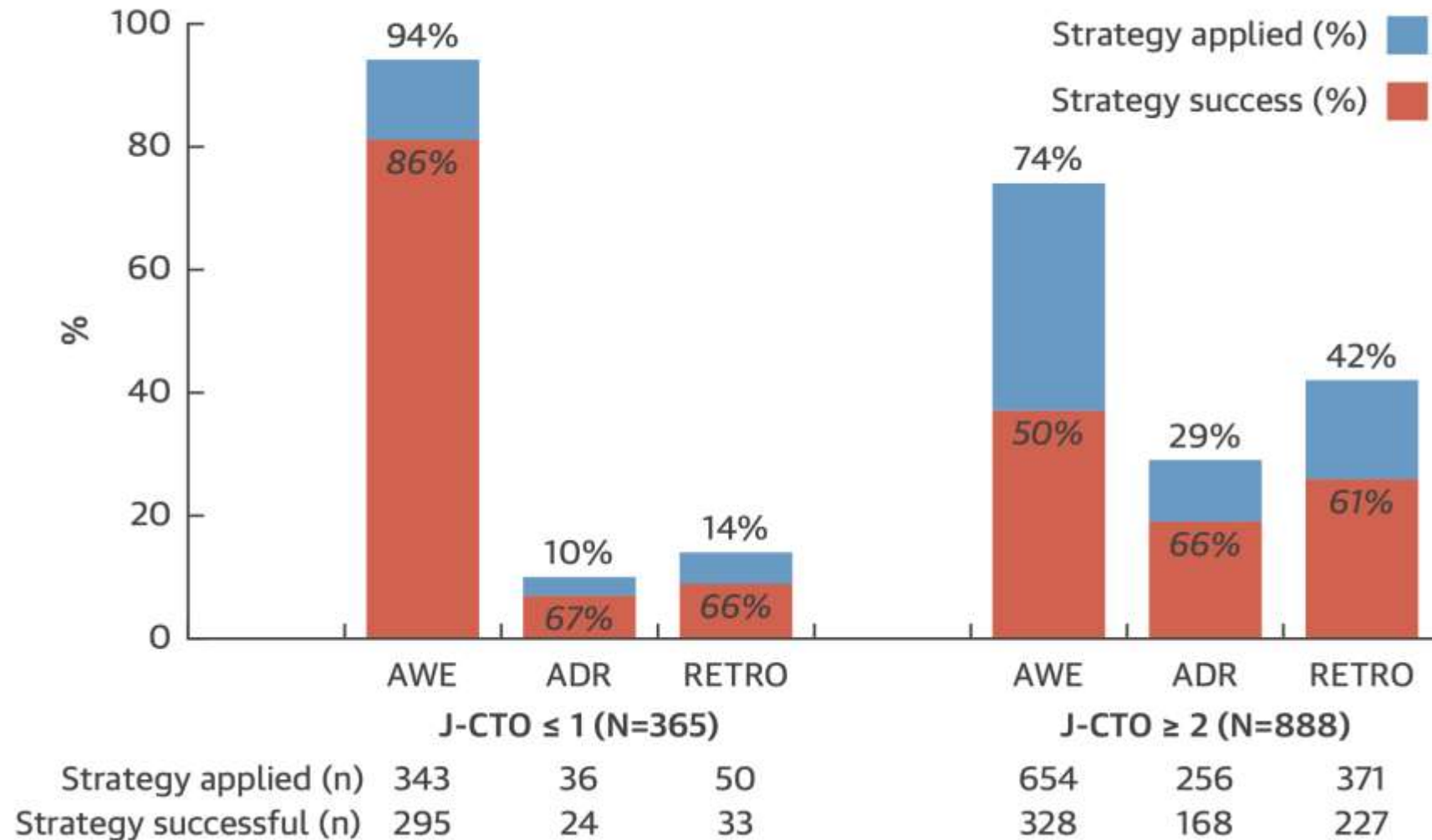


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Japanese CTO Algorithm



RECHARGE Registry: J-CTO score and AWE



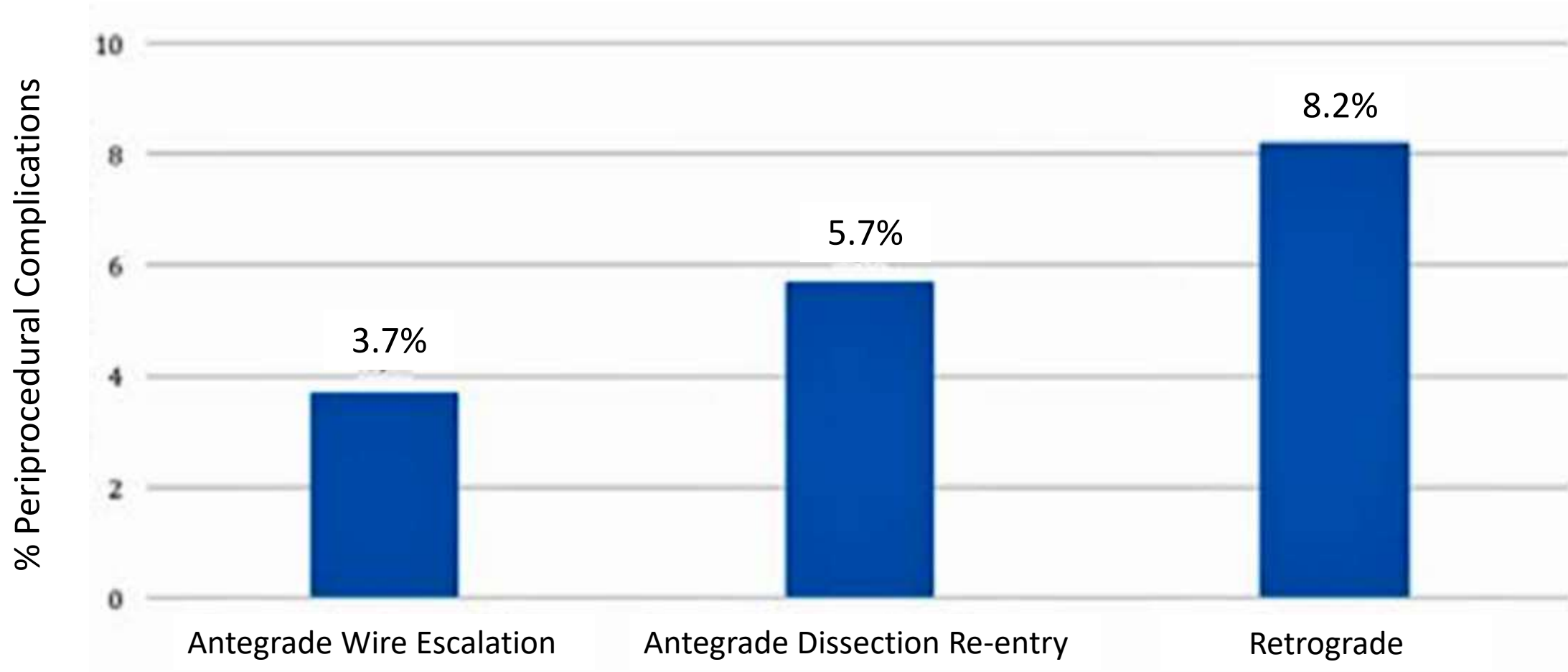
How safe is retrograde?

	Primary antegrade (n=4,281)	Primary retrograde (n=1,562)	
In hospital MACCE	1.2%	2.3%	<0.01
Coronary embolisation	0.1%	0.4%	0.02
Cardiac perforation	2.8%	7.2%	<0.01
Cardiac tamponade	0.3%	0.7%	0.01
Contrast nephropathy	5%	6.9%	<0.01

European CTO Registry: Complications by Approach



N = 17 626



Global Consensus Expert Document on CTO PCI



1	The principal indication for CTO-PCI is to improve symptoms
2	Dual coronary angiography and thorough, structured angiographic review should be performed in every case
3	Use of a microcatheter is essential for guidewire support
4	There are 4 CTO crossing strategies: antegrade wire escalation, antegrade dissection re-entry, retrograde wire escalation, and retrograde dissection re-entry
5	Change of equipment and technique increases the likelihood of success and improves the efficiency of the procedure
6	Centers and physicians performing CTO-PCI should have the necessary equipment, expertise and experience to optimize success and minimize and manage complications
7	Every effort should be made to optimize stent deployment in CTO PCI, including the frequent use of intravascular imaging

Conclusion

While there is agreement on an number of CTO principals, there remain a number of questions:

- Is it important to start with the strategy with the highest chance of success?
- Can we better define when we should switch between strategies?
- How safe is retrograde?
- Is targeted ADR safer than retrograde or vice versa?
- Should the approach depend on operator skills?

We need to get consensus and a global CTO algorithm