Hybrid Algorithm

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CTO Operator Evolution





2000

HYBRID

- HYBRID is NOT the US and Europe
- There are no RULES only Principles
- Is NOT a CLUB, but a COMMUNITY





REVERSE CART

Wiring Algorithm



COMPLEX ANATOMY NEEDS ALTERNATE METHODS OF REVASCULARIZATION

AWE Limitations

Variables (%)	pCABG (173 PCIs)	nCABG (1,121 PCIs)	p Value
Guidewiring strategy			
Parallel guidewire technique	49 (28)	335 (30)	0.68
Success	21 (43)	182 (54)	0.13
IVUS guided	24 (14)	121 (11)	0.23
Success	12 (50)	75 (62)	0.27
Overall retrograde attempt (including CART)	82 (47)	300 (37)	0.001
Success	41 (50)	174 (58)	0.19
CART technique	38 (22)	127 (11)	< 0.0001
Success	27 (71)	114 (89)	0.004

Teramoto et al J Am Coll Cardiol Int 2014:7:39-46

Success rates parallel wiring 43% post CABG Success rates parallel wiring 54% no CABG Success rates IVUS guided wiring 50% post CABG

Success rates IVUS guided wiring 62% no CABG

AWE is decreasingly successful with increasing complexity



RWE / RDR is increasingly relevant with increasing complexity



ADR is increasingly relevant with increasing complexity



Retrograde Limitations



Tsuchikane et al. CCI 2013;82:E654-661

Limitations of Retrograde Approaches

Similar updated experience from Japan Examined 5984 CTO PCIs from 45 centres (2009-12) Retrograde attempt in 1656 cases Failed to cross with wire/micro-catheter in 23%

Procedure success after collateral crossing 89% (~70% Overall)

Limitations of Retrograde Approaches

Coronary Interventions

Outcomes With the Use of the Retrograde Approach for Coronary Chronic Total Occlusion Interventions in a Contemporary Multicenter US Registry

Dimitri Karmpaliotis, MD; Aris Karatasakis, MD; Khaldoon Alaswad, MD;
Farouc A. Jaffer, MD, PhD; Robert W. Yeh, MD; R. Michael Wyman, MD;
William L. Lombardi, MD; J. Aaron Grantham, MD; David E. Kandzari, MD;
Nicholas J. Lembo, MD; Anthony Doing, MD; Mitul Patel, MD; John N. Bahadorani, MD;
Jeffrey W. Moses, MD; Ajay J. Kirtane, MD; Manish Parikh, MD; Ziad A. Ali, MD;
Sanjog Kalra, MD, MSc; Phuong-Khanh J. Nguyen-Trong, MD; Barbara A. Danek, MD;
Judit Karacsonyi, MD; Bavana V. Rangan, BDS, MPH; Michele K. Roesle, RN, BSN;
Craig A. Thompson, MD, MMSc; Subhash Banerjee, MD; Emmanouil S. Brilakis, MD, PhD



UK: Similar experience to J-Proctor

Failure to cross collateral is main stumbling block in retrograde approach

Unable to get retrograde access 23%

Unable to complete 18%

Consistent Themes on Retrograde

Not an option in many cases

Fail to cross in expert hands ~1/4 of cases

Complex epicardial collaterals may carry excessive risk to the patient

Especially for inexperienced operators & where alternative strategies are available

More Options = Higher Success

There is no panacea in CTO PCI

All approaches have failure modes

Failure rates increase as anatomical complexity increases

The more options we have available, the more likely success becomes

Starting the Procedure

- Know your patient and the indication
 - No ad hoc CTO PCIs
 - Study the old films and know location of previous grafts
- Evaluate
 - Proximal and distal caps of the CTO- ambiguity?
 - Quality of distal re-entry zone or is distal cap at bifurcation
 - Interventional collaterals? (septals, epicardials, old grafts)
 - Do they connect?
 - How do they connect? Straight-shot or tortuous
 - Lesion length (> or <20mm)

Examples of Evaluating CTOs



No cap ambiguity Length <20mm Good distal landing zone +/- Interventional collaterals No cap ambiguity Length >20mm Good distal landing zone Difficult collaterals





Cap ambiguity Length >20mm Good distal landing zone Interventional collaterals

The Hybrid Algorithm for CTO PCI



The Hybrid Approach to CTO-PCI

increasing success and efficiency

- Systematic
- Adoption of four strategies
- Sequence based on probability of success
- Rapid decision making



The Hybrid Algorithm

Four things determine how many and which option to begin with

1. Proximal Cap Anatomy

- Defined or Ambiguous?
- 2. Target
 - Favorable for reentry?
- 3. Collaterals
 - Useable or not?
- 4. Occlusion length
 - <20mm or ≥20mm?</p>



ALGORITHMIC APPROACH

Common Problems Encountered in CTO PCI – Algorithms for success

- 1. Wire Impenetrable cap
- 2. Wire will cross cap/lesion but gear won't follow
- 3. Cap ambiguity Proximal
- 4. Cap ambiguity Distal (usually post-CABG)
- 5. Cannot externalize wire after crossing retrograde
- 6 Unexpanded stent in lesion

- 7 Wire across but microcatheter won't follow Septals
- 8 Wire across but microcatheter won't follow -Epicardials
- 9 Wire/gear keeps going into a side branch within a lesion
- 10. Difficult ADR
- 11 Failure to complete R-CART
- 12 Difficult suture line to cross
- 13Hematoma management with ADR

Wire Across Cap/Lesion but Gear Won't Follow

- 1. Increase support: amplatz the guide, guideliner, anchor balloon
- 2. Small balloon (1.5mm X 20mm) inflations for pre-dilation
- 3. BAM with same balloon
- 4. Switch to stiffer microcatheter (Turnpike gold, Tornus)
- 5. Laser atherectomy
- 6. External cap crush
- 7. Carlino
- 8. Use micro 014/Finecross microcatheter to deliver a short roto wire and perform rotational atherectomy
- 9. Go retrograde
- 10. See wire impenetrable cap algorithm

CASE WALK THROUGH

LAD occlusion



Long LAD CTO

Blunt proximal cap Good landing zone Septal collateral chanel

Comes in at distal cap

IVUS guided proximal cap puncture



Penetrative wire through the cap followed by microcatheter





CrossBoss causes more controlled dissection



Decision to proceed with CrossBoss



CrossBoss advanced through the CTO



Switch out for Stingray

• Deliver Miracle 12 wire

• Remove CrossBoss (trapping balloon used)

• Bring in Stingray balloon

• Inflate and orientate

Stingray delivered – wrong orientation



Orientating the Stingray balloon



Correct orientation



Stingray orientated above the lumen



Stingray wire stick – from different case



Swap for Pilot 200 and rewire



Confirm distal position



Final result after DES implanted.



12 month follow up OCT as part of clinical study



Complete healing including the area of dissection and sub-intimal stenting



Case 2

Outside RCA Angiogram





Outside LCA Angiogram



Turned down for CABG surgery at OSH due to low LVEF and concern for need for LVAD in the future

RCA Set Up



Lost Anterograde? Try Retro



LCX ADR



LCX PCI







LAD PCI



Greater chance of success = Hybrid Skills







Hybrid Approach







Procedural Results in OPEN



119 \pm 72 min



2.5 \pm 1.9 Gy



265 ± 194 ml



Guidewire classes

- Initial wire Pilot 200 penetrates without perforation
- 2nd wire Penetration wire (ie really stiff)
 - Confienza Pro 12, Hornet 14, Astato
 - should never be used to cover more than 1 cm
- Knuckle wires (polymer jacketed wires)
 - Fielder XT, Fighter, Pilot 200
 - These will tell you they are in the architecture or whether you have gone into a branch

Guidewire classes

- Retrograde wires for RDR
 - Gaia 3rd (torques best)
 - CP 12 or Hornet 14 to fenestrate the media when in failure mode
 - Stiff polymer wire Pilot 200, Gladius
- Externalization wire long wires
 - RG3 stainless steel easier to deliver, easier to kink
 - R350 nitinol, slightly harder to deliver, doesn't kink

Microcatheter classes

- Retrograde catheters 150cm
 - Corsair, turnpike LP workhorse
 - Caravel, Micro 014, finecross back ups
- Antegrade Catheters 135 cm
 - Turnpike spiral, Corsair workhorse
 - Caravel, micro 014, fine cross

Wire across device won't follow

- Turnpike Gold, Tornus

Tools: Keys to remember

- •Each tool has a strength and a weakness
- •Don't get stuck or think one device is perfect
- •Wires are often the most dangerous tools in our hands
- •Trust the 'knuckle'
- •The more you know those the better the choices you will make

What does Hybrid really mean

- Evolution and Consistency
- Understanding tools
- Accepting Failure and moving on
- Architecture over lumen
- Use devices and techniques to help you understand where you are
- Learn from both success and failure

If you only do what you can do, you'll never be better than what you are.