

# How To Choose and Cross IC

**PAUL HL KAO, MD**  
**PROFESSOR OF MEDICINE**  
**NATIONAL TAIWAN UNIVERSITY**  
**HOSPITAL**

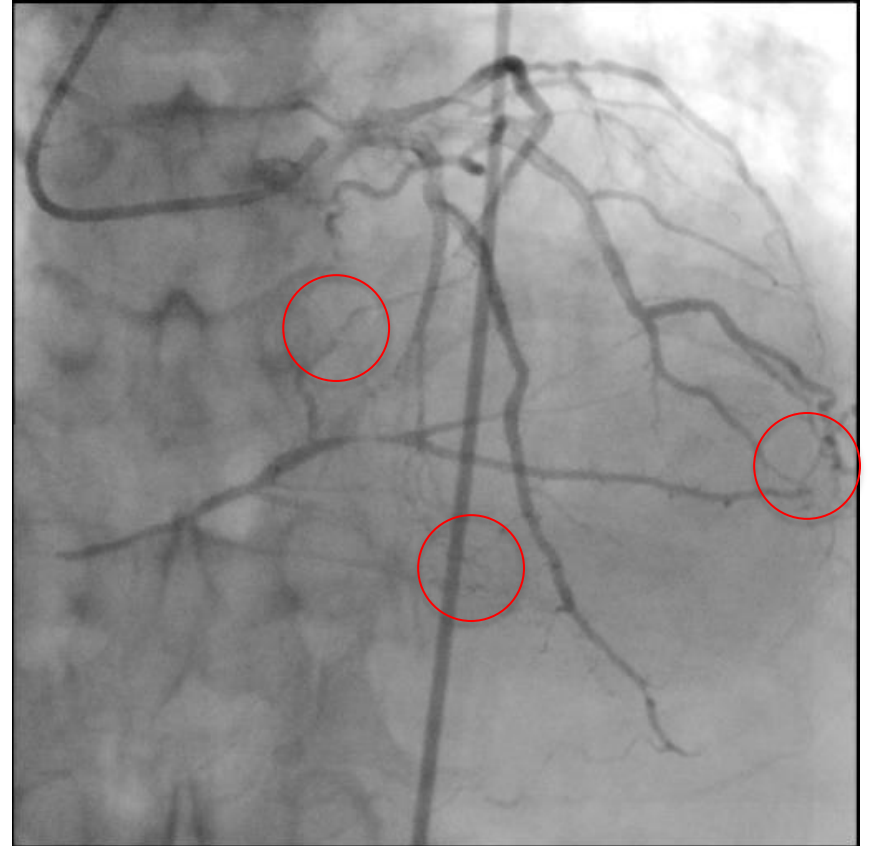
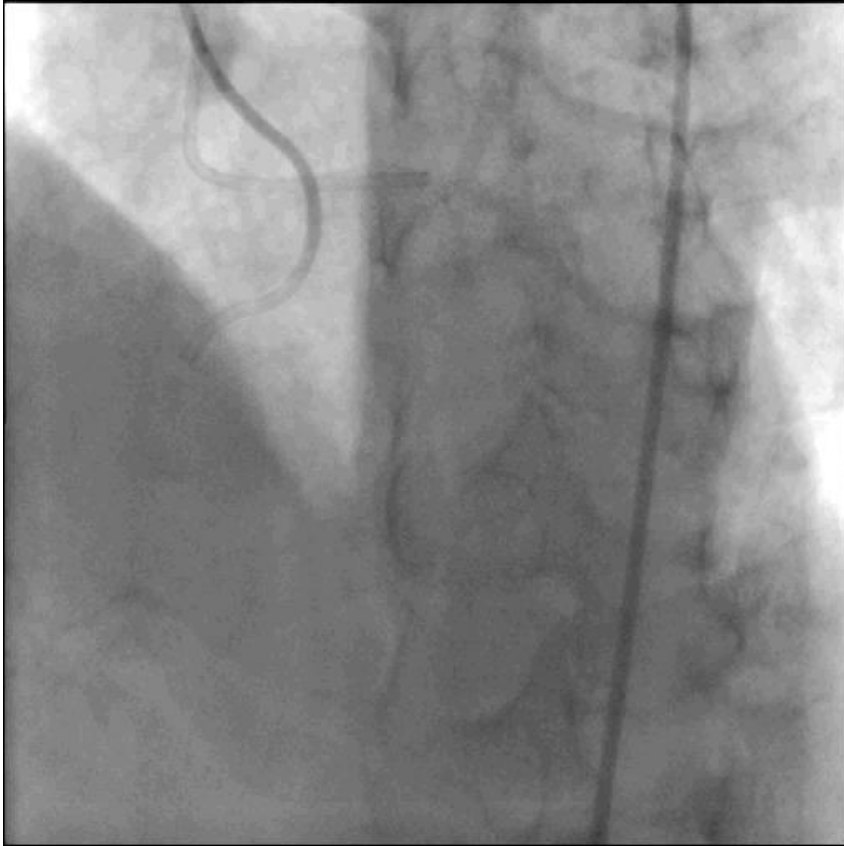
# Disclosure

- I have nothing to disclose in the following presentation

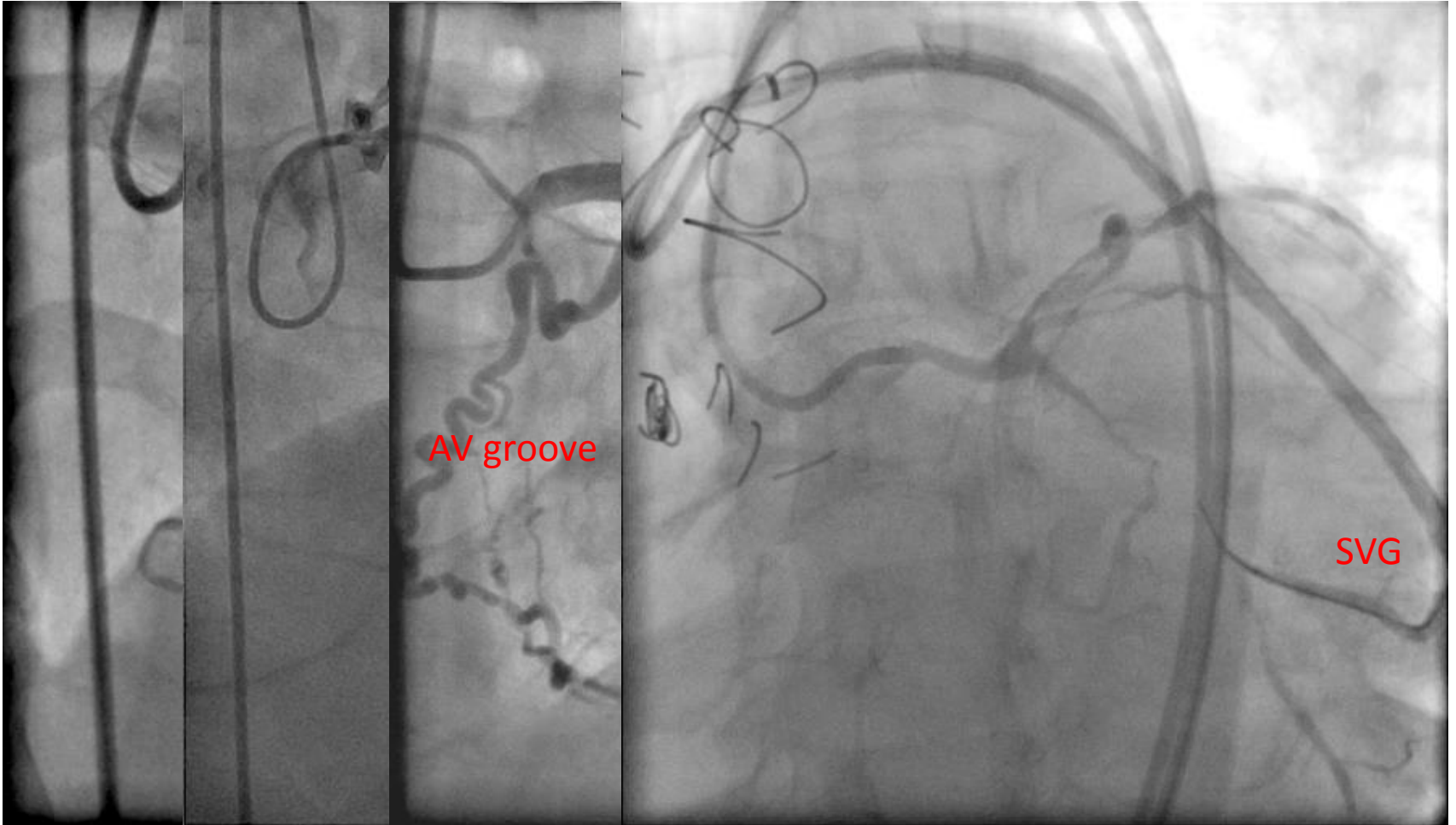
# IC tracking is the key step

- Once IC tracking successful, final success is usually >95%
- Complication occurs most frequently during IC tracking
- Multiple IC often seen in 1 CTO, but selection is subject to operator preference
- Septal usually preferred, and surfing advocated, **BUT is it really so?**

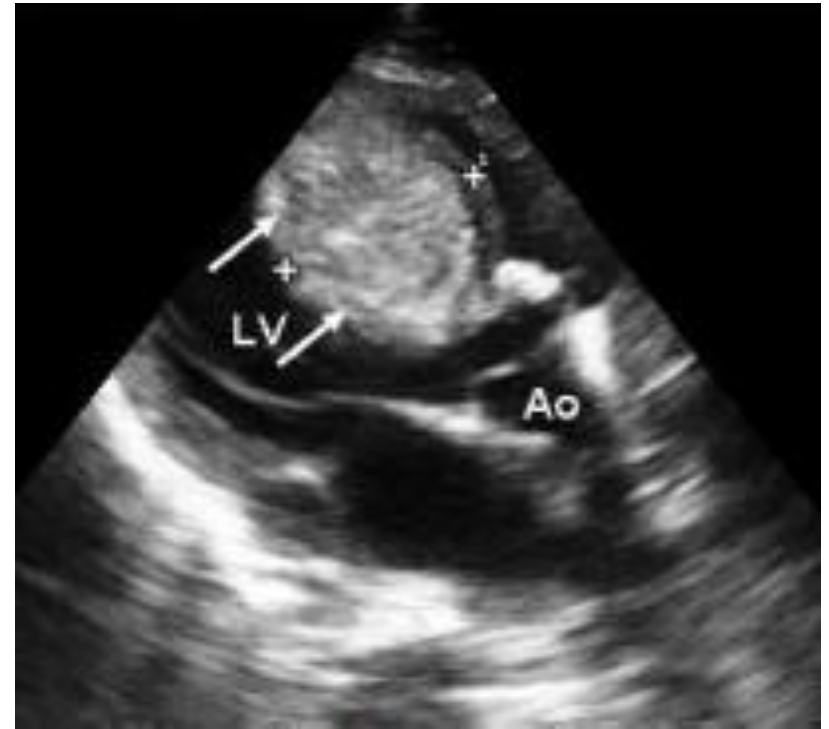
# Multiple IC



# IC types

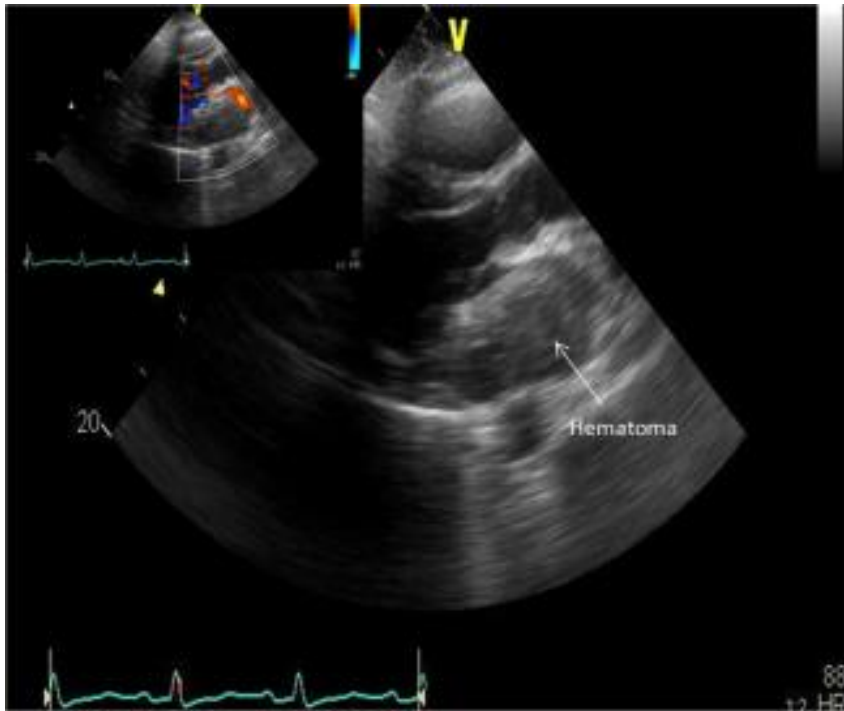


# Septal hematoma

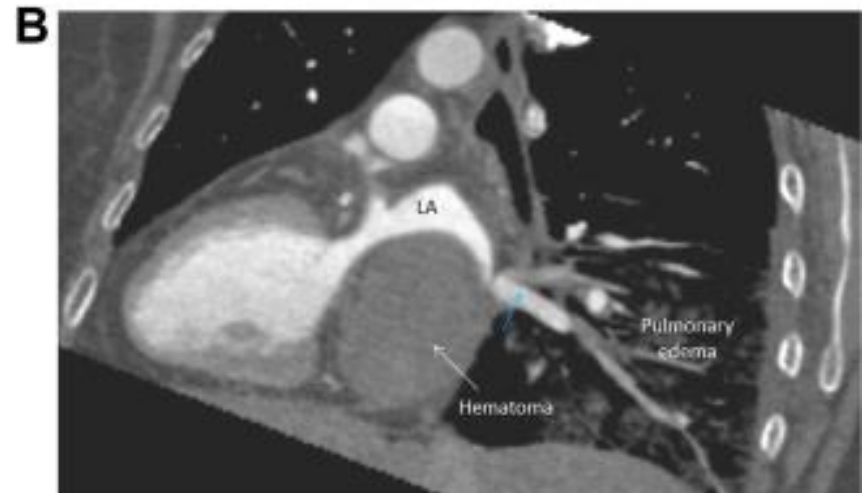
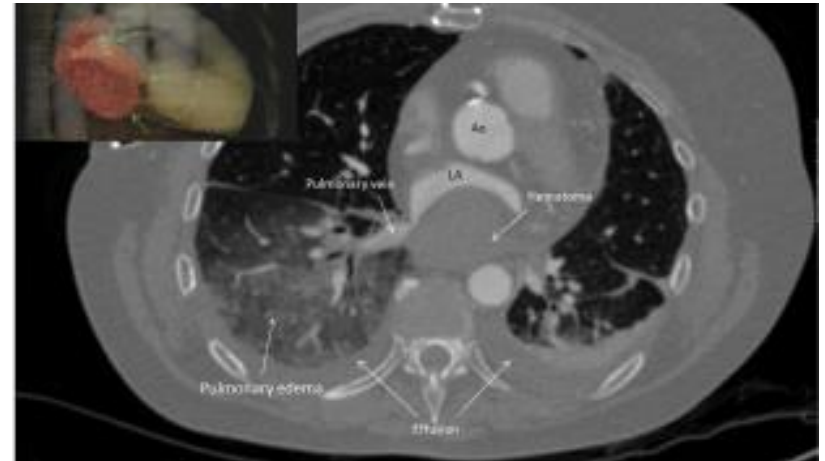


Dry tamponade and/or  
LVOT/RVOT obstruction

# LA hematoma



LA inflow/outflow obstruction  
or annulus deformity causing  
MR



# Channel size

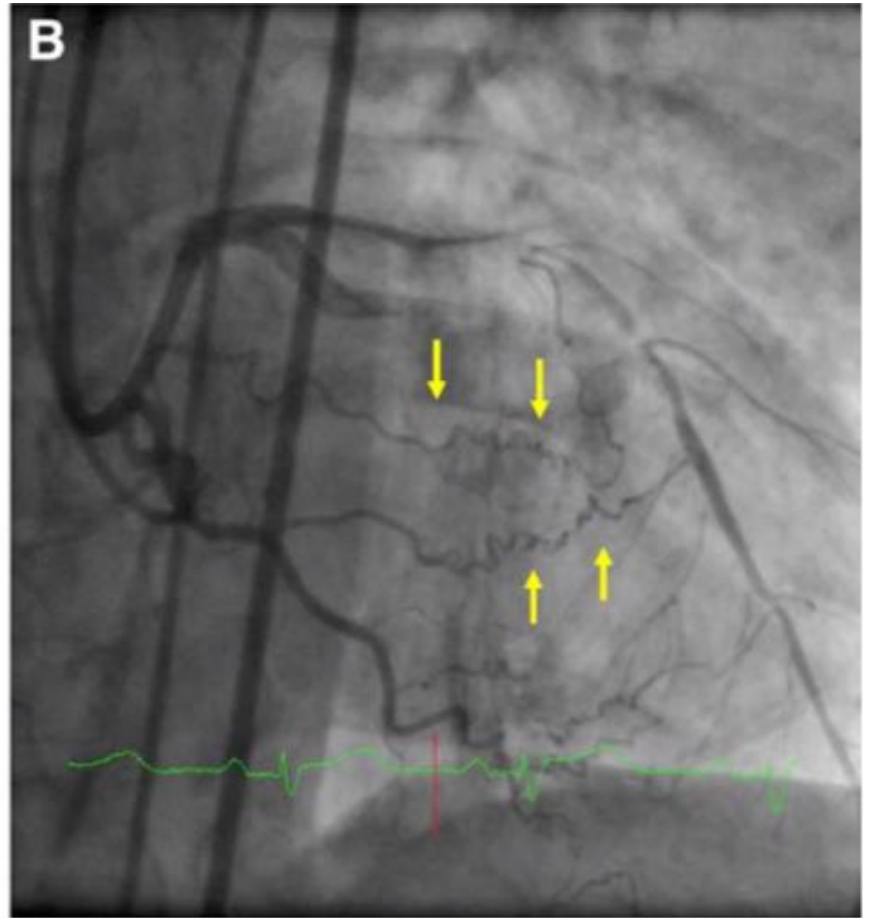
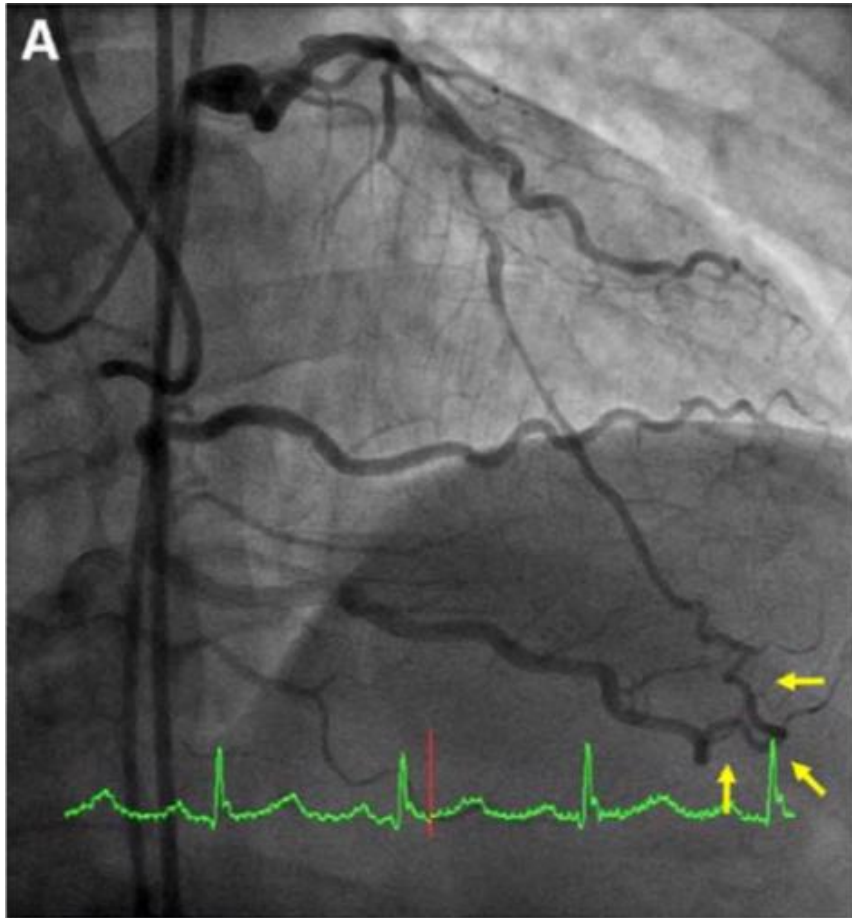
- CC 0: no continuous connection between donor and recipient artery
- CC 1: continuous, threadlike connection
- CC 2: continuous, small side branch–like size of the collateral throughout its course



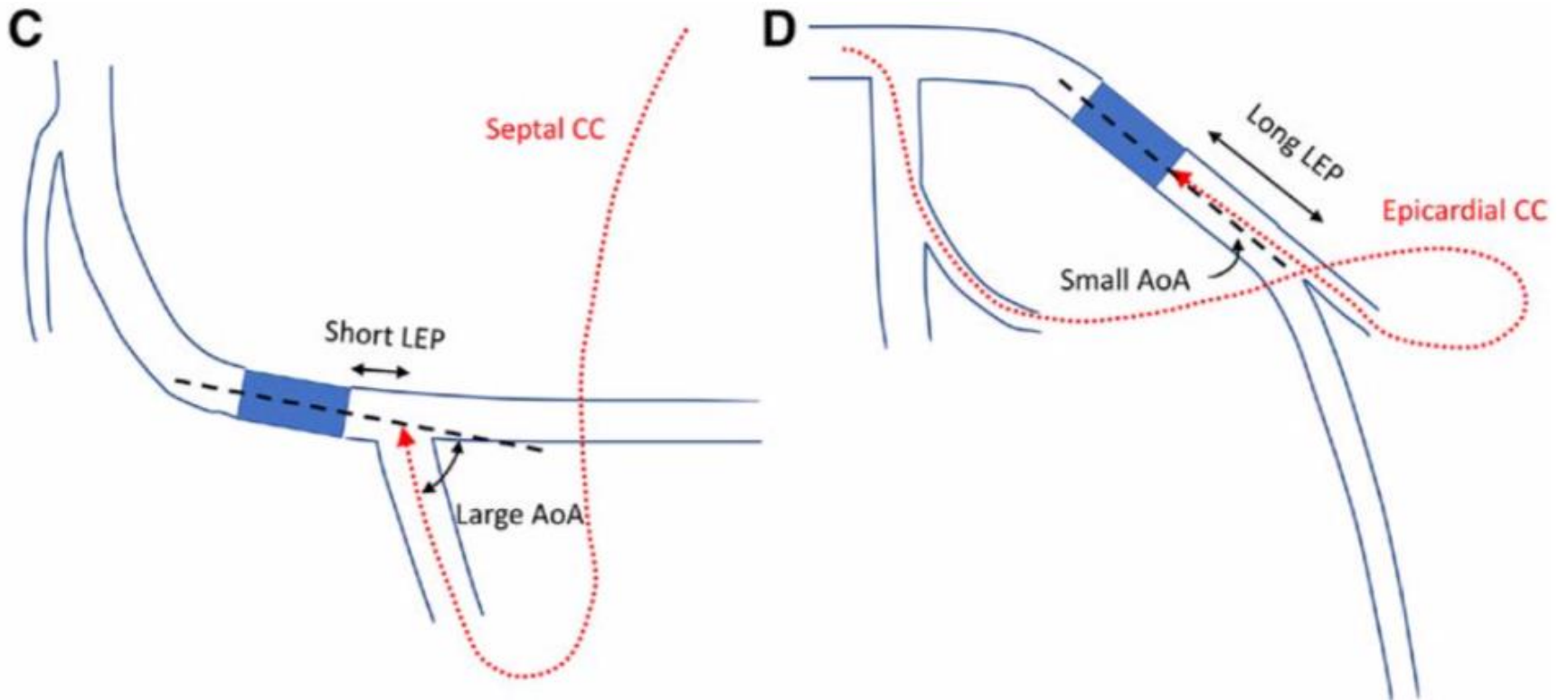
# Channel tortuosity

- $\geq 2$  high-frequency successive curves (within 2mm) in epicardial IC, or  $\geq 1$  high-frequency curve that failed to uncoil in diastole for septal IC
- A high-frequency curve is defined as a curve that is  $>180^\circ$  within a segment length  $<3$  times the diameter of the collateral

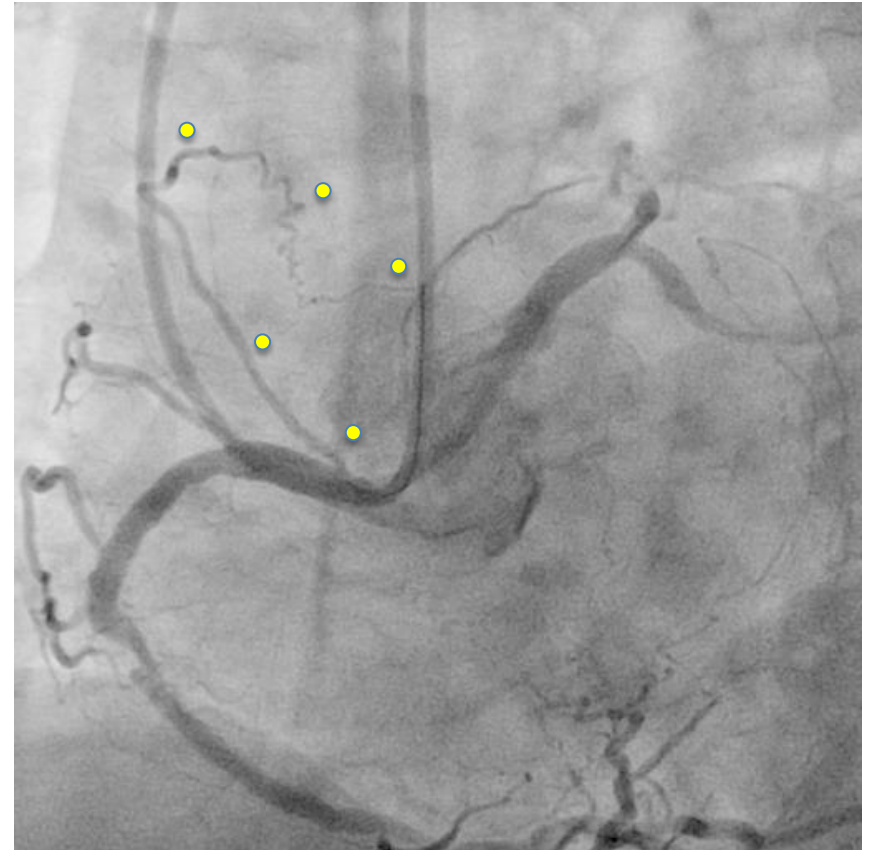
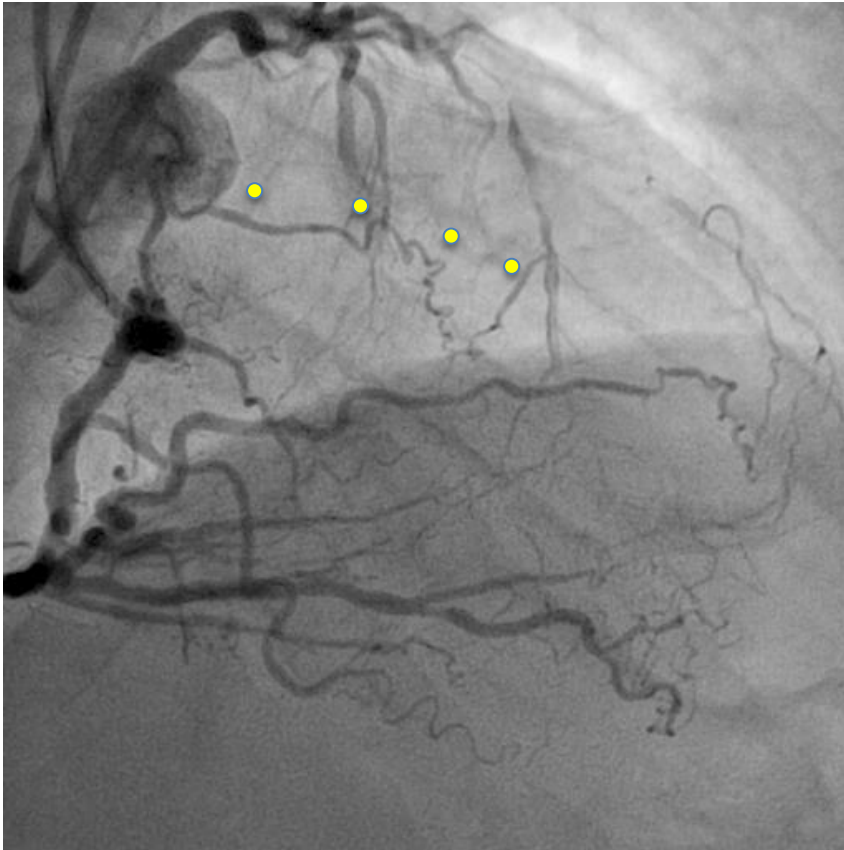
# Tortuosity and size



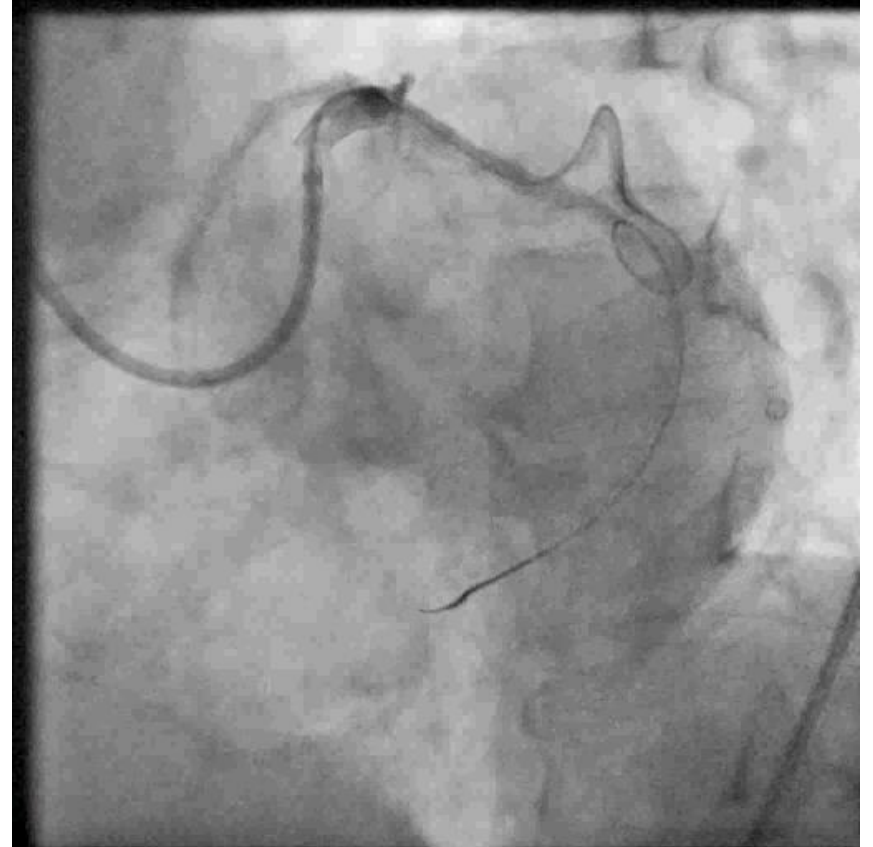
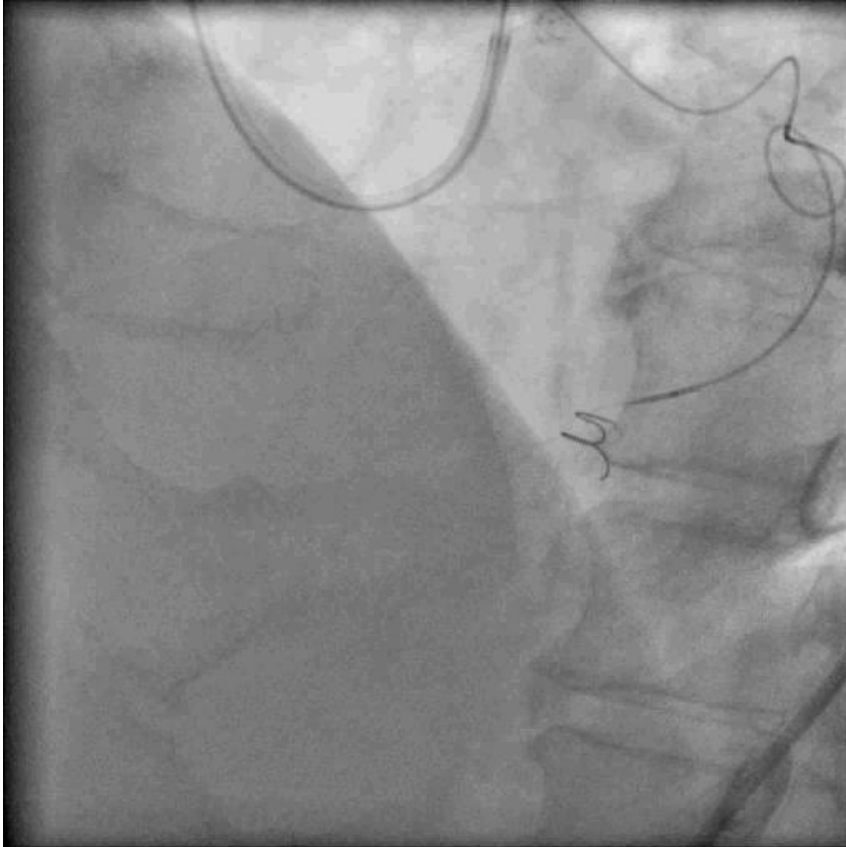
# AoA and LEP



# IC take off and retro GC choice



# Cardiac cyclic motion



# Coronary Interventions

## Collateral Channel Size and Tortuosity Predict Retrograde Percutaneous Coronary Intervention Success for Chronic Total Occlusion

Ching-Chang Huang, MD; Chih-Fan Yang, MD, PhD; Chi-Sheng Hung, MD, PhD; Ying-Chieh Chen, MD, PhD; Chih-Fan Yang, MD, PhD

**Background**—There is little evidence on the relationship between collateral channel (CC) characteristics and retrograde chronic total occlusion (CTO) percutaneous coronary intervention (PCI) success. We investigated the relationship between angiographic predictors of CC tracking and technical success.

**Methods and Results**—From a single-center retrospective study, 100 consecutive retrograde CTO percutaneous coronary intervention patients at a tertiary university-affiliated hospital were enrolled. The clinical and angiographic characteristics analyzed included channel type, size, tortuosity, and the Multicenter CTO Registry of Japan score. The Multicenter CTO Registry of Japan score was calculated. A total of 242 CCs were attempted for intervention. CC tracking success rate (per CC) was 81.4%. The per-patient technical success rate was 91.2%, and the per-patient procedural success rate was 4.6%. The atrioventricular groove, epicardial, and septal CCs were attempted in 100 (41.3%), 100 (41.3%), and 122 (50.4%) tracking attempts, respectively. In multivariable analysis, only large size and lack of tortuosity were significant independent predictors of CC tracking and technical success. A scoring system was developed, while large size was given 1 point and lack of tortuosity was given 2 points. The area under the curve for the new model to predict CC tracking and technical success were 0.800 and 0.800, respectively.

**Conclusions**—In retrograde CTO percutaneous coronary intervention, only size and tortuosity of a CC are independent angiographic predictors of CC tracking and technical success. (*Circ Cardiovasc Interv.* 2018;11:e005124. DOI: 10.1161/CIRCINTERVENTIONS.117.005124.)

**Key Words:** collateral circulation ■ coronary angiography ■ percutaneous coronary intervention

So how do we choose?



# Types don't matter, tortuosity/size do!

Variables		P Value
Per CC (n=242)		
CC tracking success rate (%) (per CC)	202/242 (83.5%)	
Septal	100/122 (82.0%)	0.80
Epicardial	71/84 (84.5%)	
AVG	31/36 (86.1%)	
First CC attempted in a procedure	183/216 (84.7%)	0.30
Second CC attempted in a procedure	17/23 (73.9%)	
Third CC attempted in a procedure	2/3 (66.7%)	
Technical success rate (%) (per CC)	197/242 (81.4%)	
Septal	99/122 (81.1%)	0.77
Epicardial	70/84 (83.3%)	
AVG	28/36 (77.8%)	
First CC attempted in a procedure	178/216 (82.4%)	0.49
Second CC attempted in a procedure	17/23 (73.9%)	
Third CC attempted in a procedure	2/3 (66.7%)	
CC perforation-related cardiac tamponade	5/242 (2.07%)	
Septal	1/122 (0.81%)	0.31
Epicardial	3/84 (3.57%)	
AVG	1/36 (2.78%)	

	Univariable		Multivariable	
	OR (95% CI)	P Value	OR (95% CI)	P Value
Large size	4.14 (2.05–8.38)	<0.001	2.94 (1.35–6.43)	0.007
Lack of tortuosity	9.93 (4.32–22.83)	<0.001	9.02 (3.77–21.5)	<0.001
AoA <45°	1.82 (0.9–3.69)	0.096	1.12 (0.5–2.53)	0.78
LEP >5 mm	0.66 (0.2–2.12)	0.48		
AVG	1.27 (0.46–3.49)	0.65		
Epicardial	1.13 (0.55–2.32)	0.75		
Septal	0.80 (0.41–1.59)	0.53	0.68 (0.31–1.51)	0.35
J-CTO score	0.75 (0.47–1.2)	0.23		
First CC attempted	2.03 (0.79–5.21)	0.14		

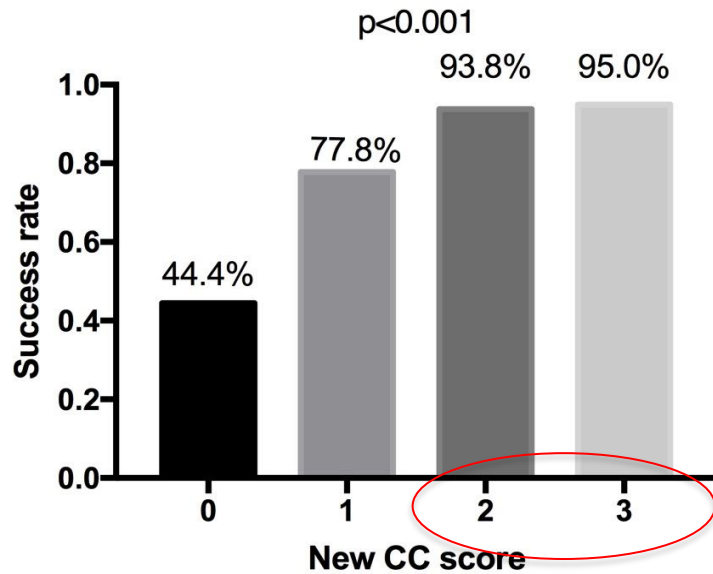
# R score assignments

- IC specific, can be counted individually if multiple IC choices present
  - 1 point for CC 2, 0 points for CC 0/1
  - 2 point for non-tortuous, 0 point for tortuous
  - IC class, AoA, LEP, etc. are minor “technical” issues and no points assigned
- R score  $\geq 2$  predicts IC tracking/overall success rates of  $\geq 90\%$

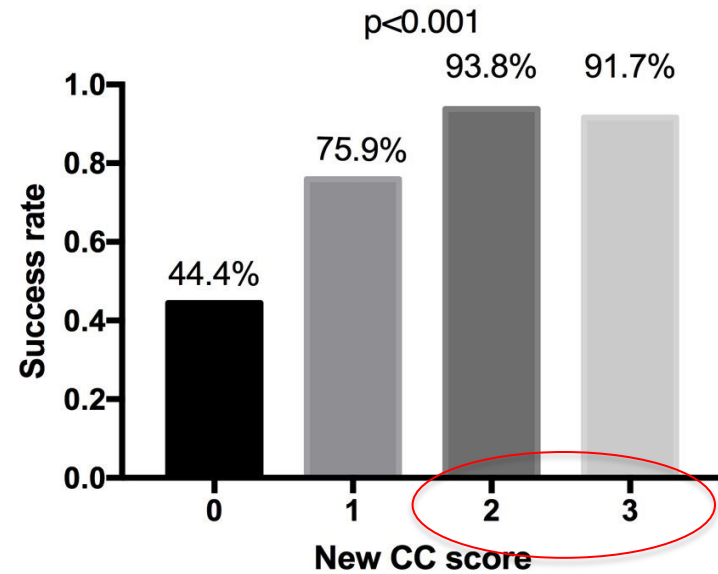


# Prediction based on R score

CC tracking success by new CC score

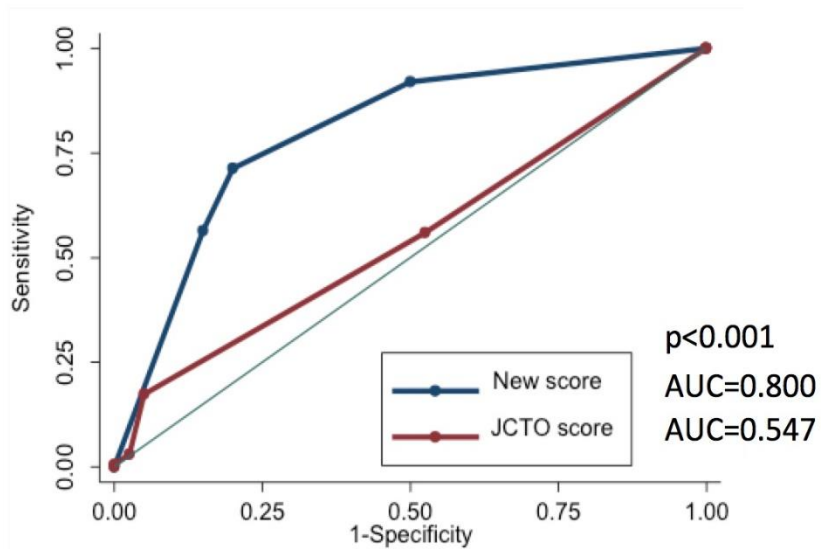


Technical success by new CC score

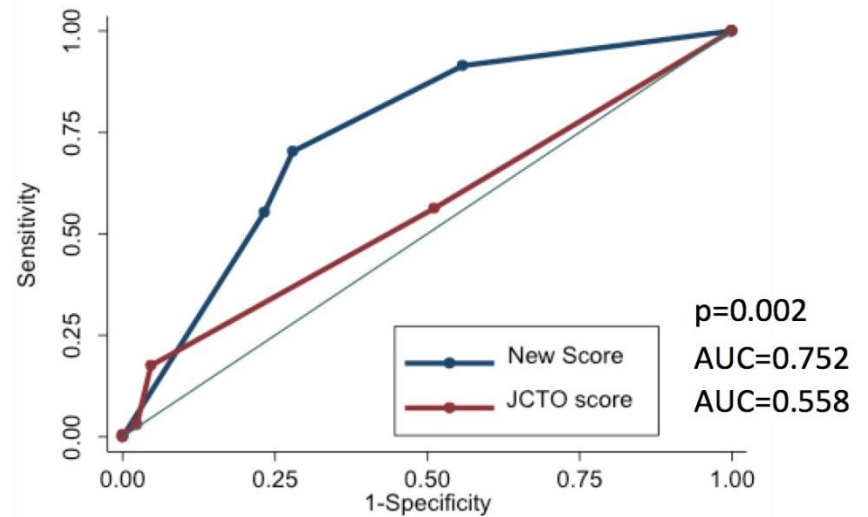


# Comparison with J-score

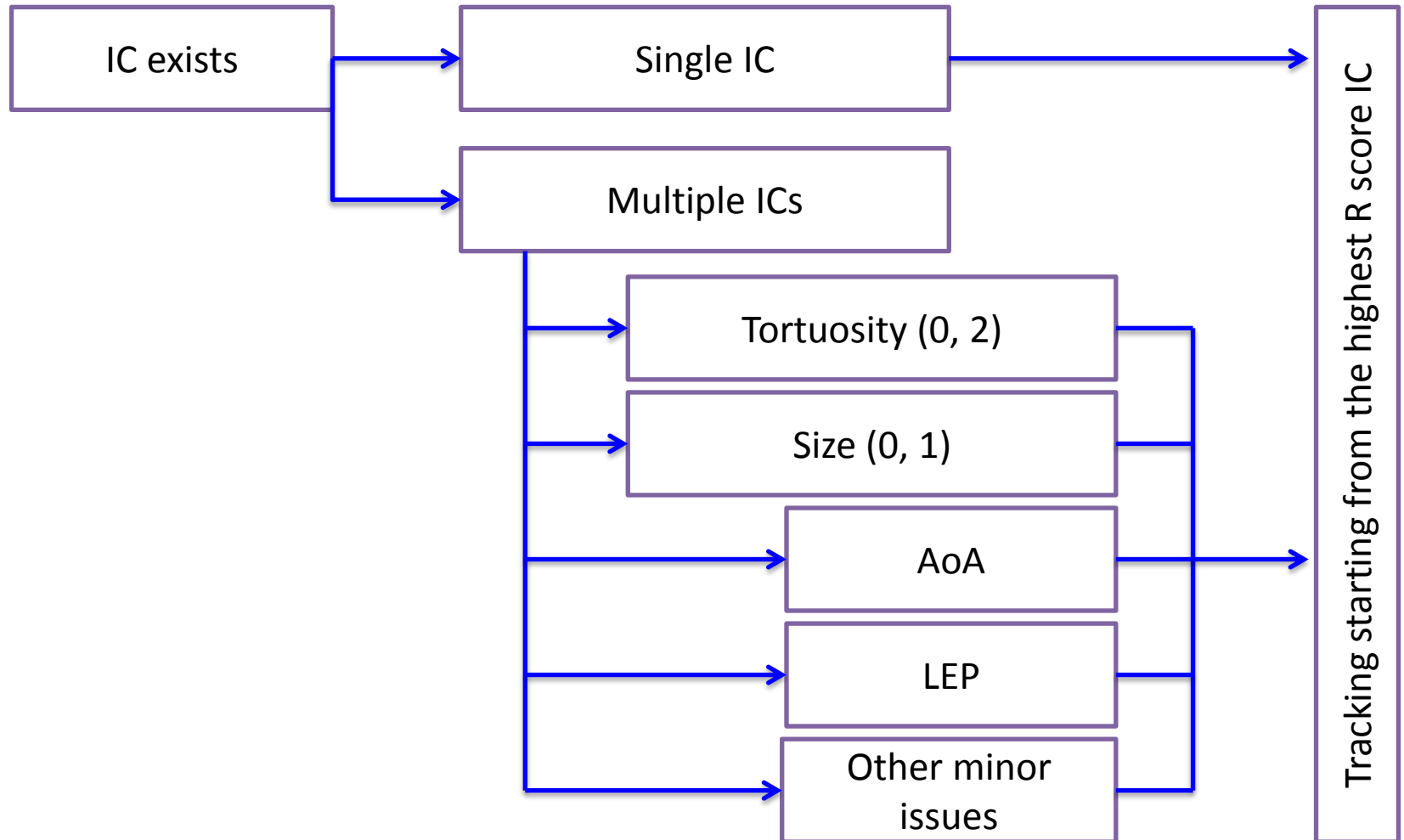
## CC tracking success



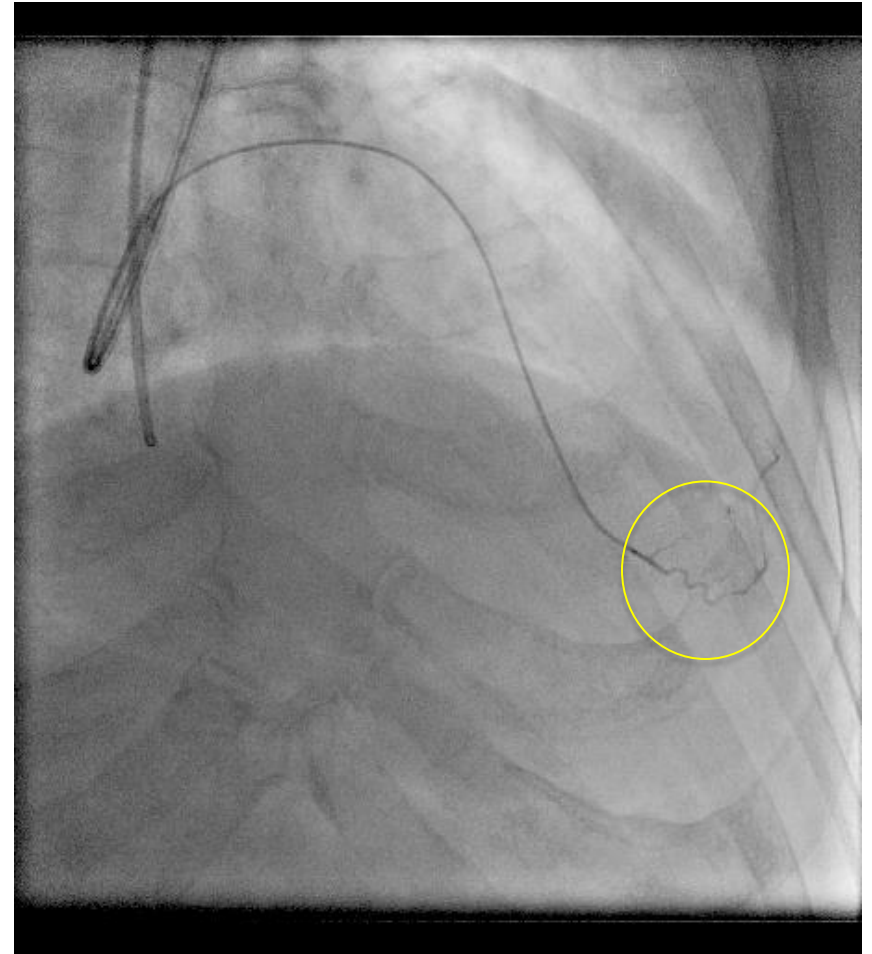
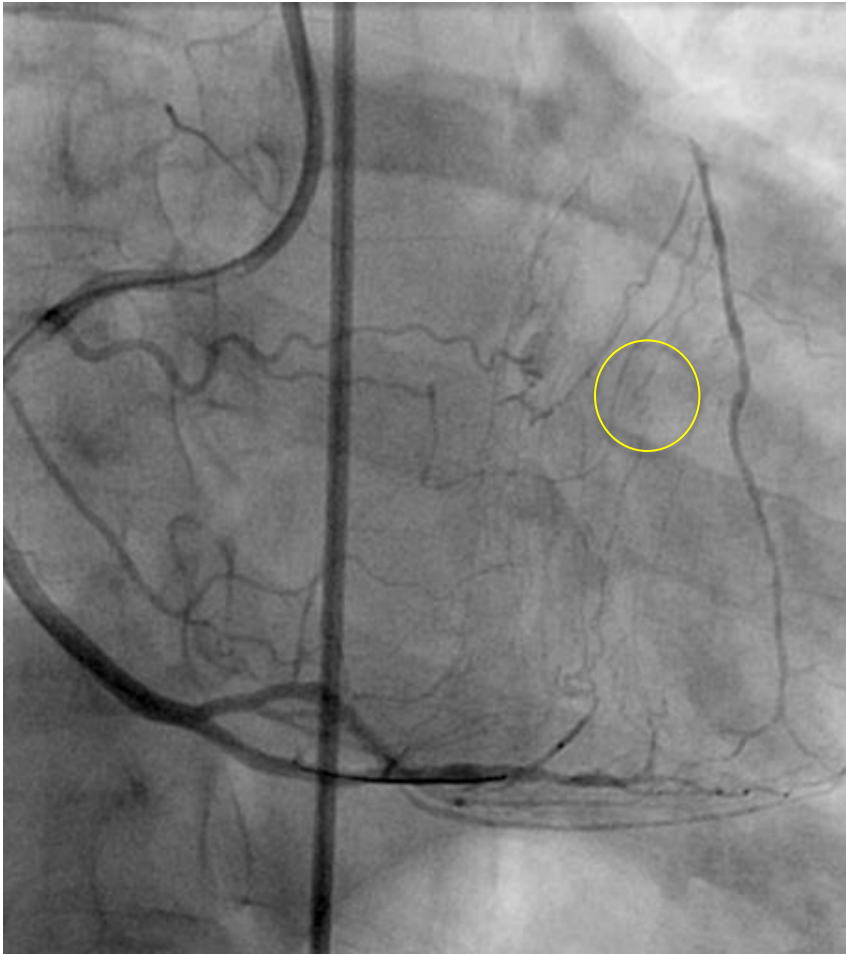
## Technical success



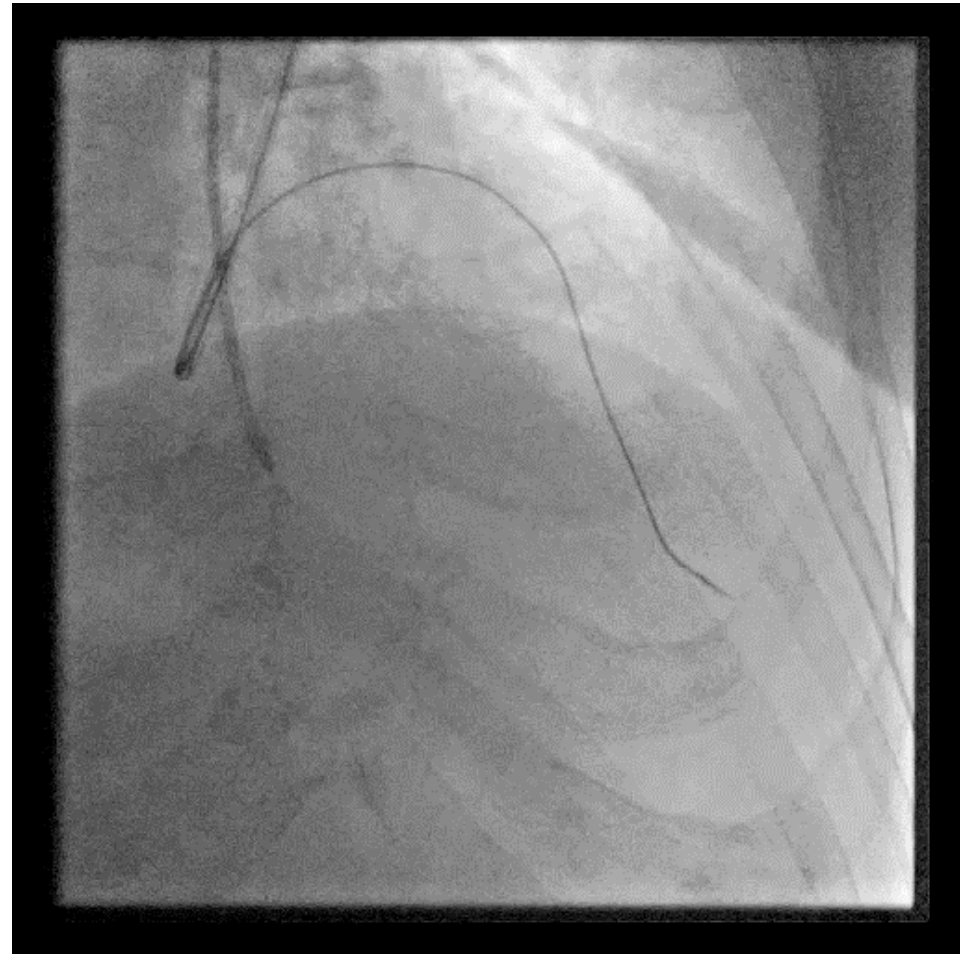
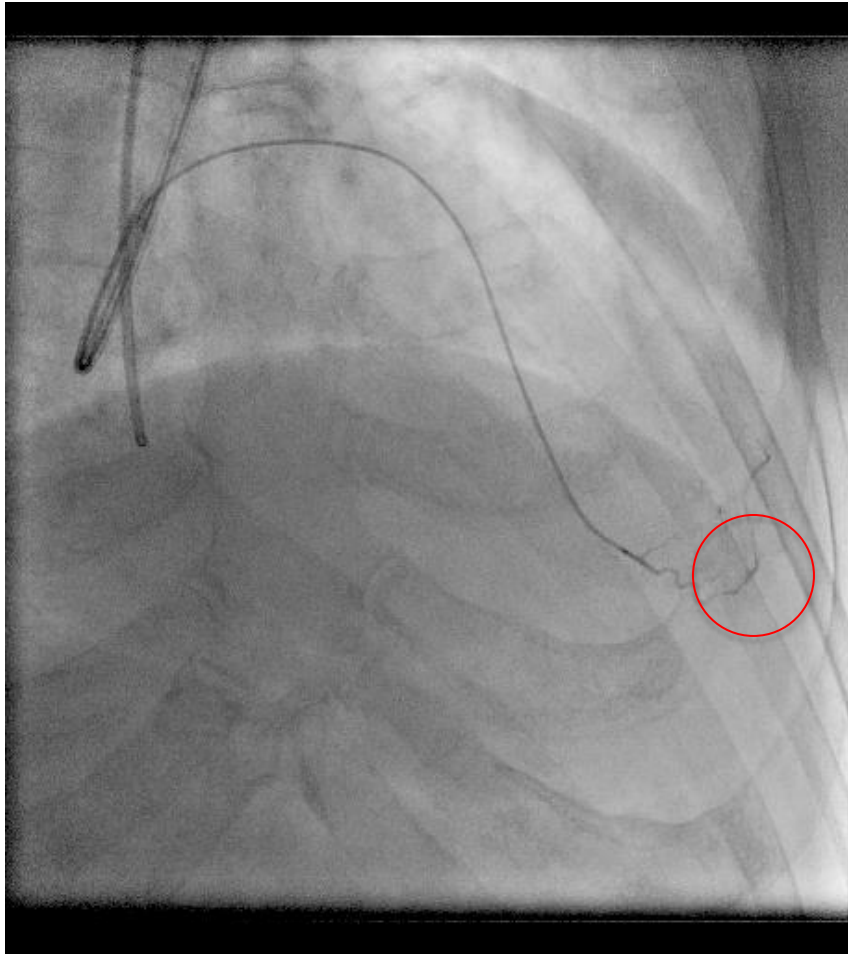
# IC selection algorithm



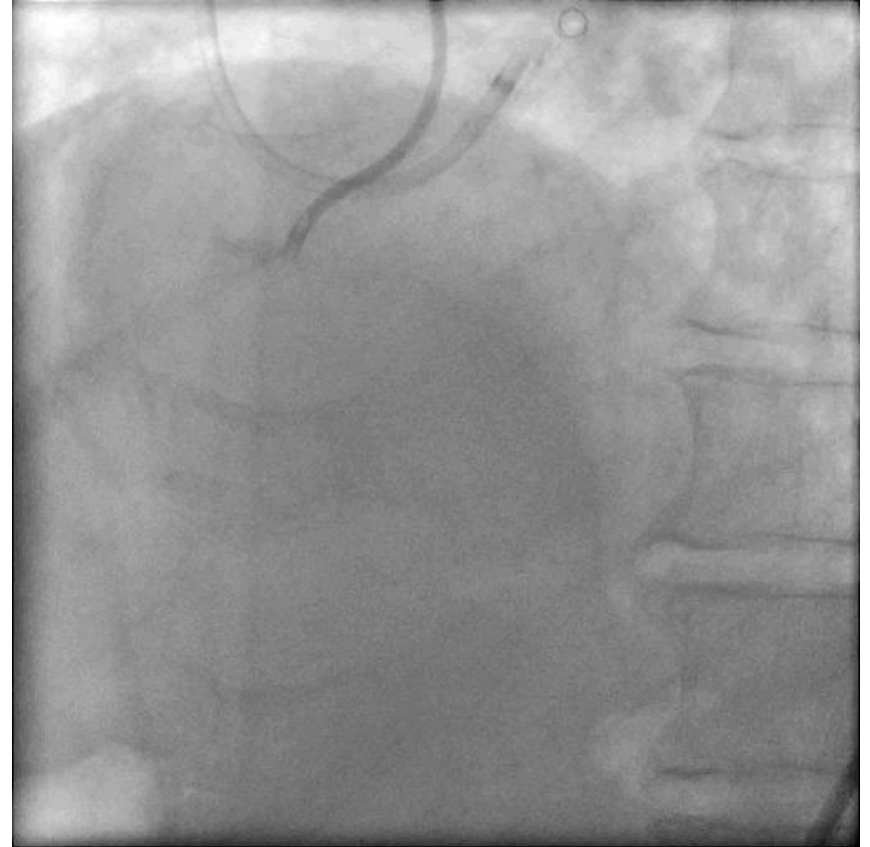
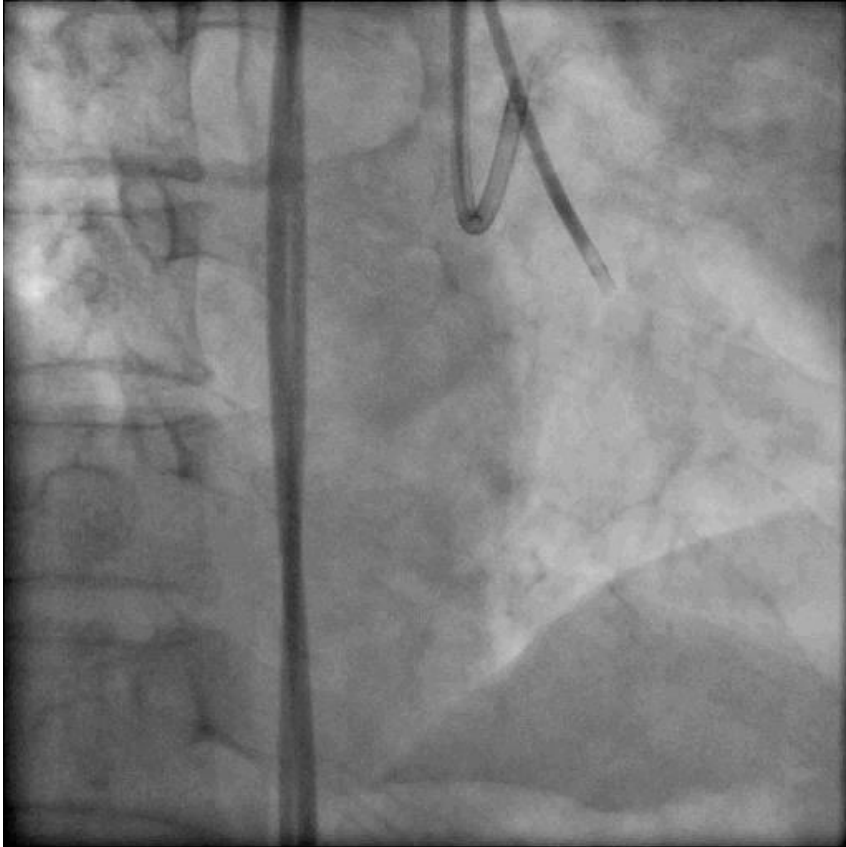
# 1-pointer vs 3-pointer



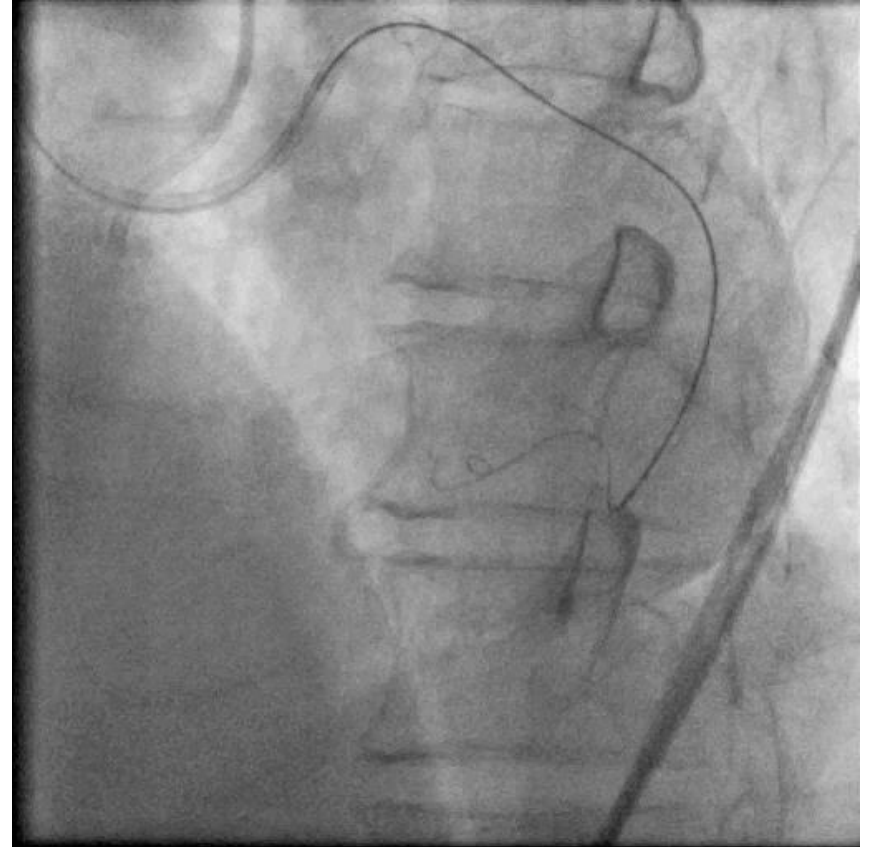
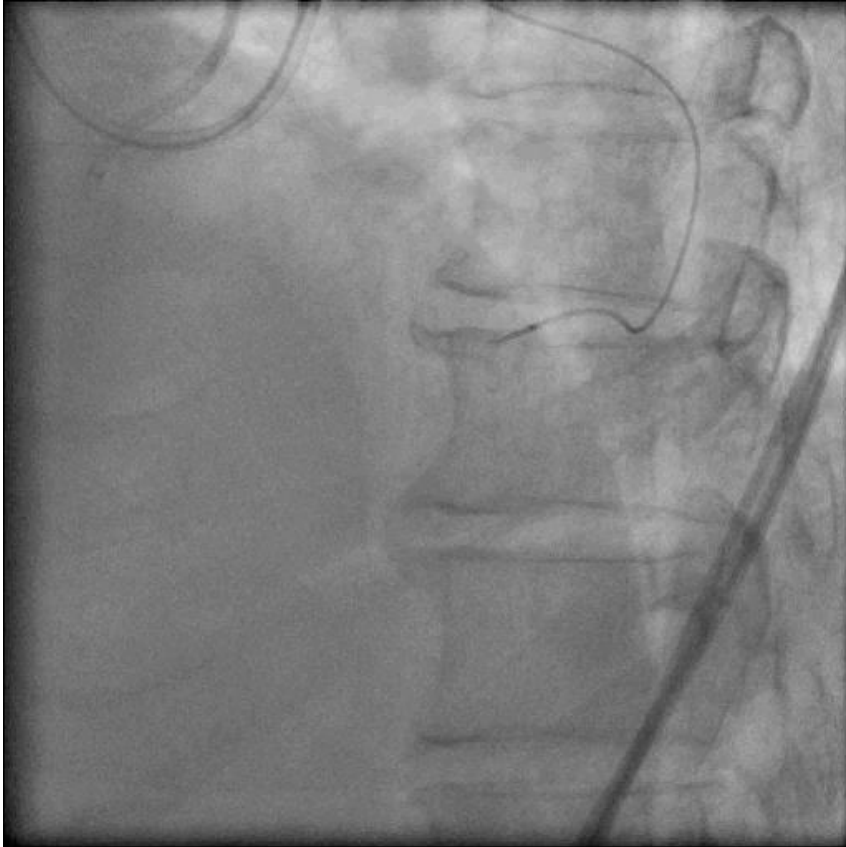
# Epi IC tracking



# AVG IC chosen

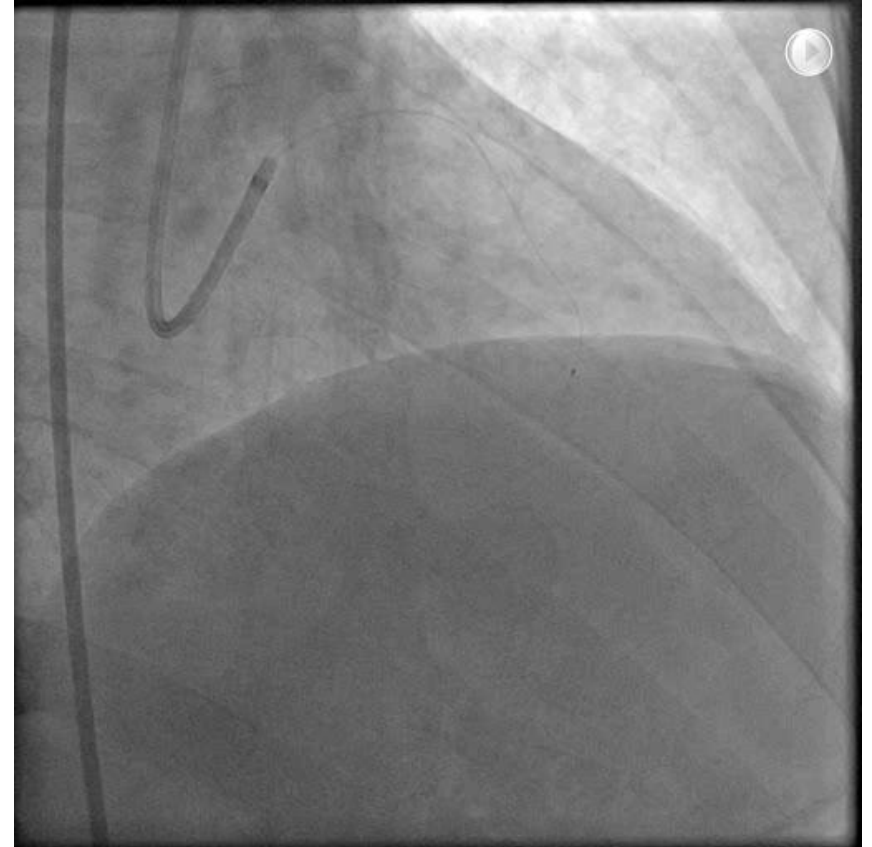
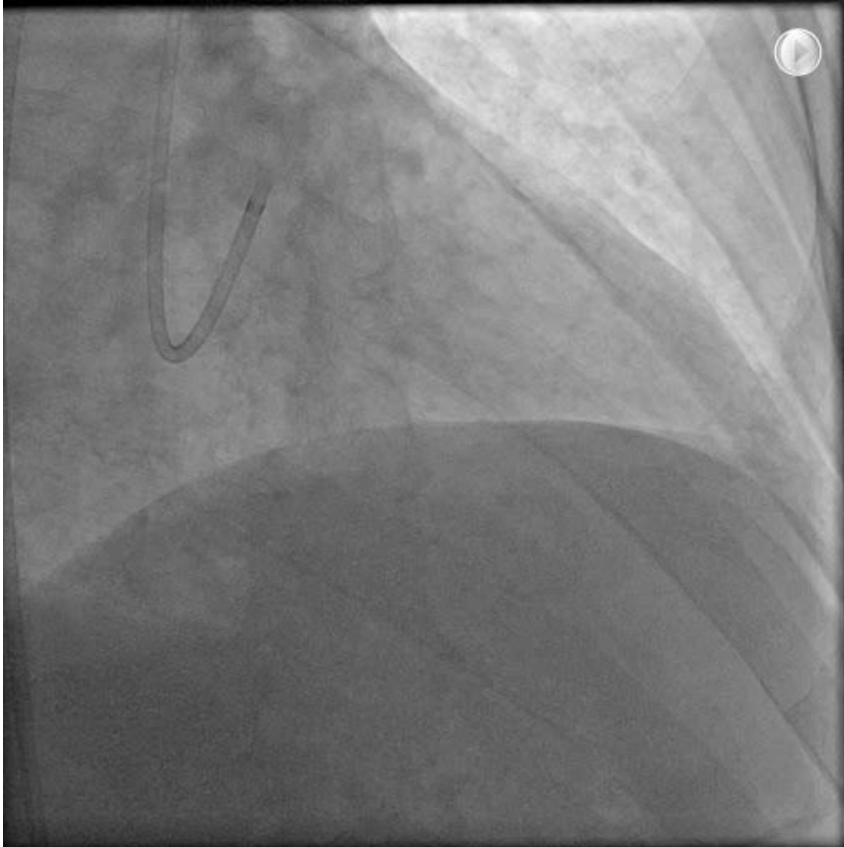


# Isolate and cross



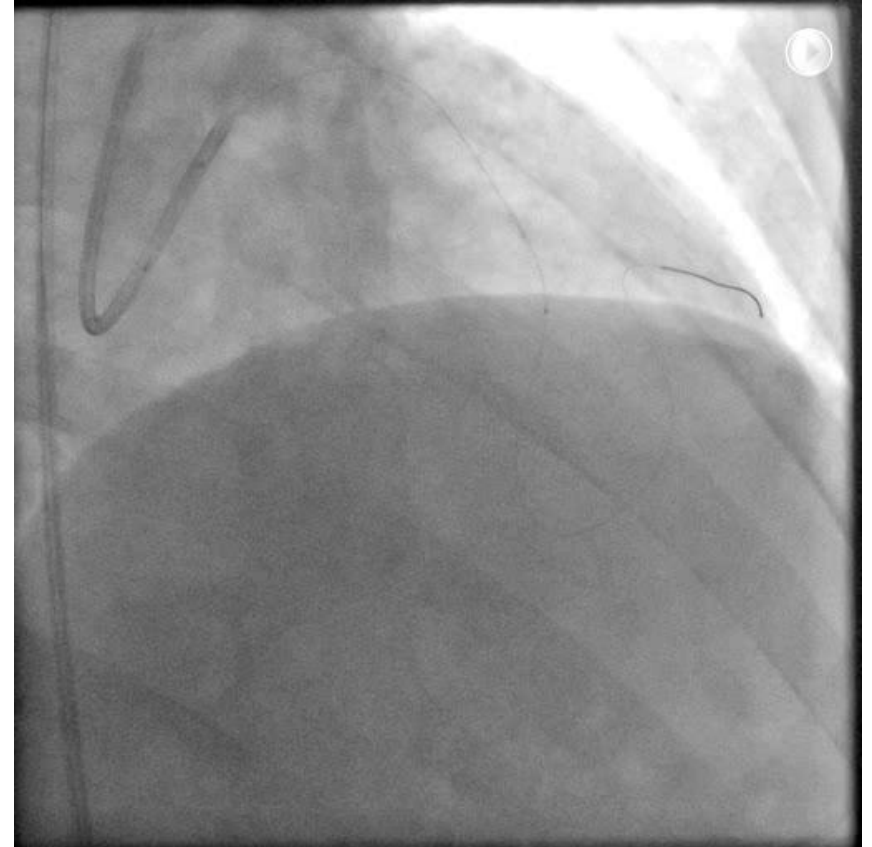
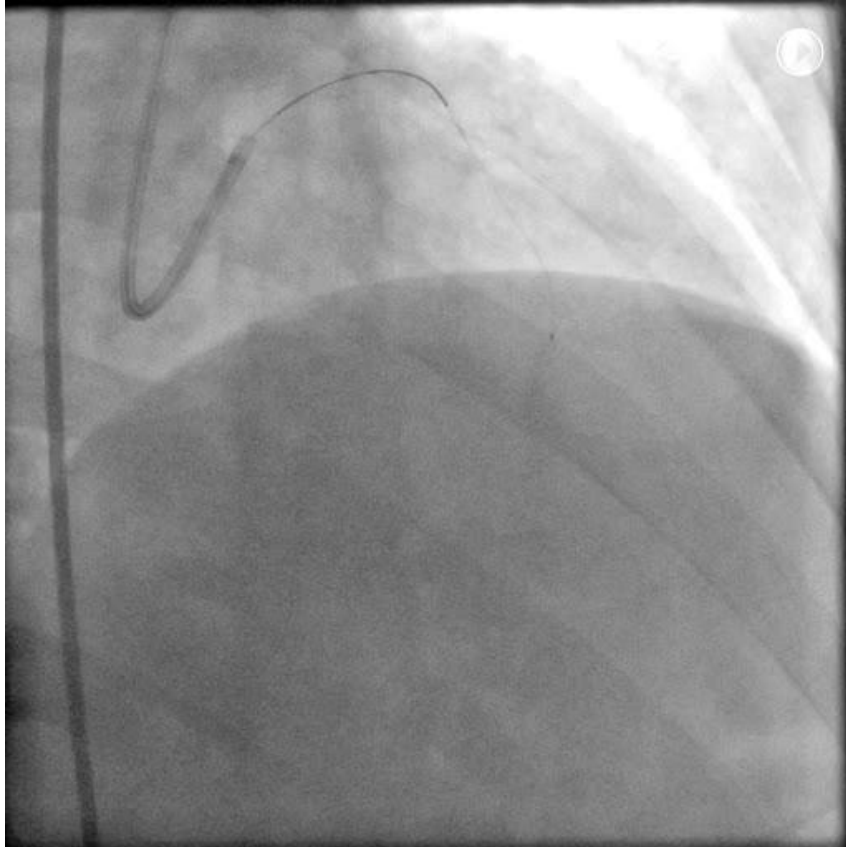


# Ipsi Sep-Sep IC





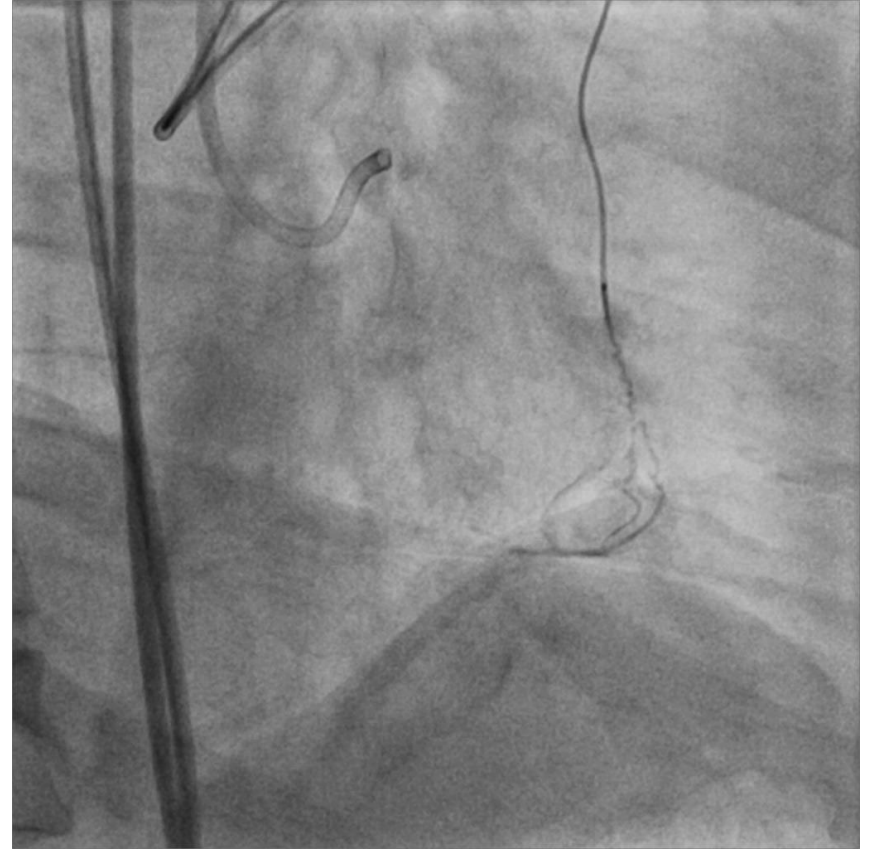
# Suoh 03 / Finecross tracking



# Conclusion

- IC tracking is the most critical step in retrograde CTO PCI
- Selection of IC using R score is recommended
- Careful choice and manipulation of devices is the key to success

# Tip injection to isolate IC



# Synchronize with cardiac cycle

