



**Essences of CTO-PCI
from Master's View**

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Disclosure

Within the past 12 months, the presenter or their spouse/partner have had a financial interest/arrangement or affiliation with the organizations listed below.

Physician Name**Company/Relationship****Etsuo Tsuchikane, MD, PhD****Abbott Vascular, Japan Consultant****Boston Scientific, Japan Consultant****Asahi Intecc, Japan Consultant**



Essences of PCI of CTOs

1. Why?

2. When?

3. How?

4. Who?



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Why Open CTOs ?

- Improved Symptoms
- Improved LV function/survival
- Improved future tolerance of contra-lateral coronary artery occlusion
- Reduce need for future CABG
- Reduce arrhythmias

CTO-PCI quality of life benefit

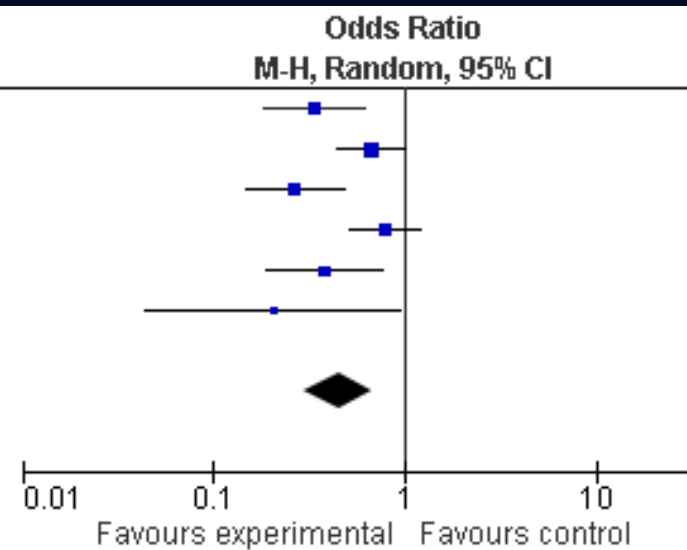
Long-term survival free from Angina in success vs. failure

Study or Subgroup	PCI success		PCI failure		Weight	Odds Ratio M-H, Random, 95% CI
	Events	Total	Events	Total		
Angioi et al.	27	90	56	100	17.5%	0.34 [0.18, 0.61]
Drozd et al.	120	280	79	149	22.1%	0.66 [0.45, 0.99]
Finci et al.	43	100	74	100	17.6%	0.27 [0.15, 0.48]
Ivanhoe et al.	90	286	53	144	21.6%	0.79 [0.52, 1.20]
Olivari et al.	28	248	15	60	15.4%	0.38 [0.19, 0.77]
Warren et al.	3	26	7	18	5.7%	0.20 [0.04, 0.95]
Total (95% CI)		1030		571	100.0%	0.45 [0.30, 0.67]

Total events

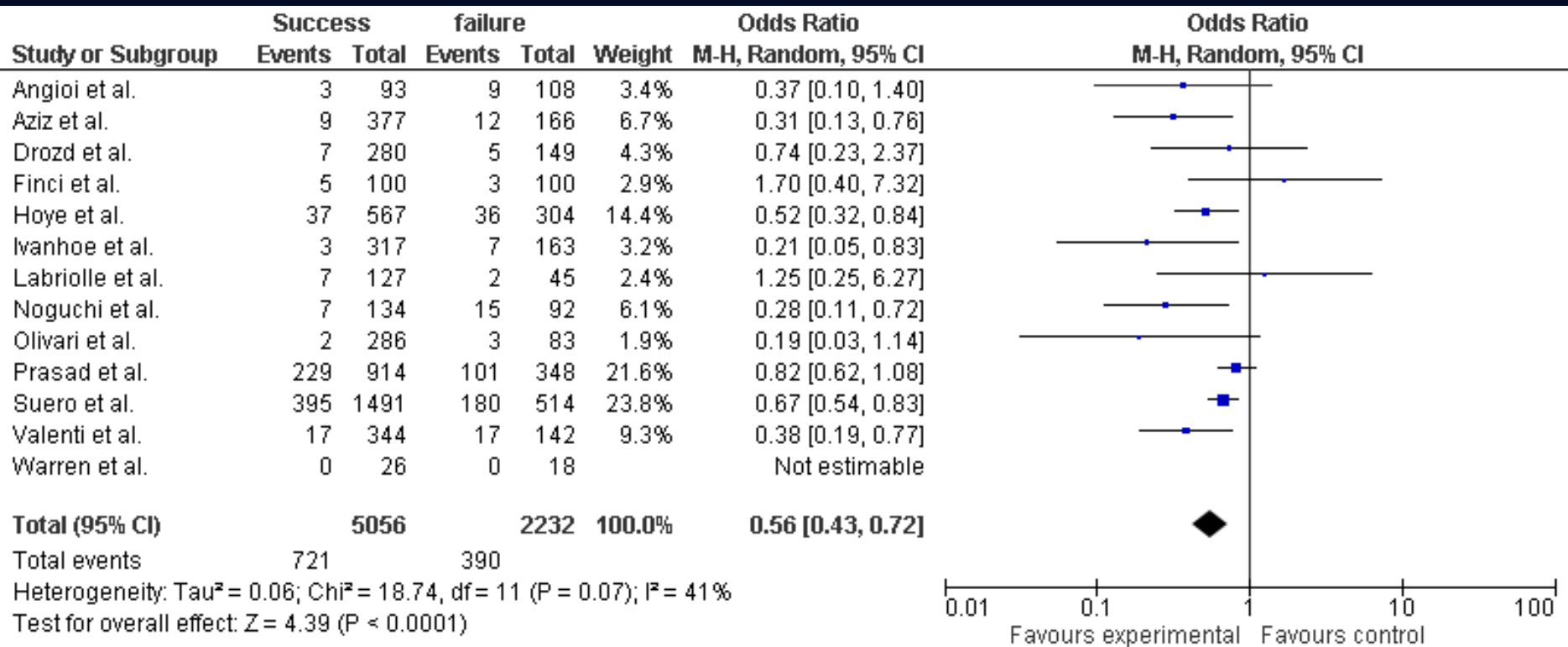
311

284

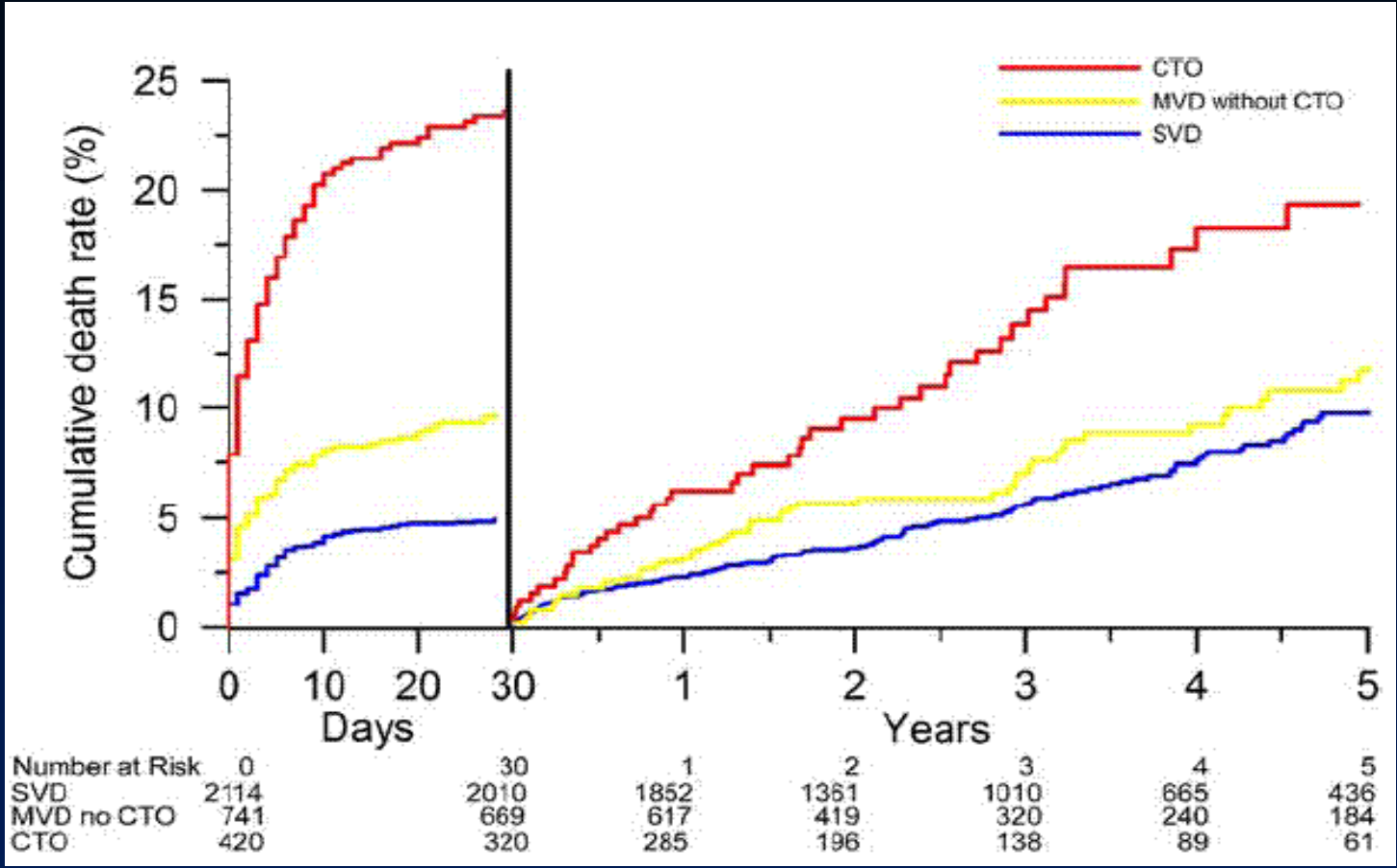
Heterogeneity: $\tau^2 = 0.16$; $\chi^2 = 14.27$, $df = 5$ ($P = 0.01$); $I^2 = 65\%$ Test for overall effect: $Z = 3.84$ ($P = 0.0001$)

Ischemic burden and survival

Long-term survival in success vs. failure



Concurrent CTO in STEMI



Independent predictors of a fall in EF at follow up

Age>60	1.9 (1.0-3.4) p=.03
CTO	3.5 (1.6-7.8) p<.01



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We should open all CTOs?

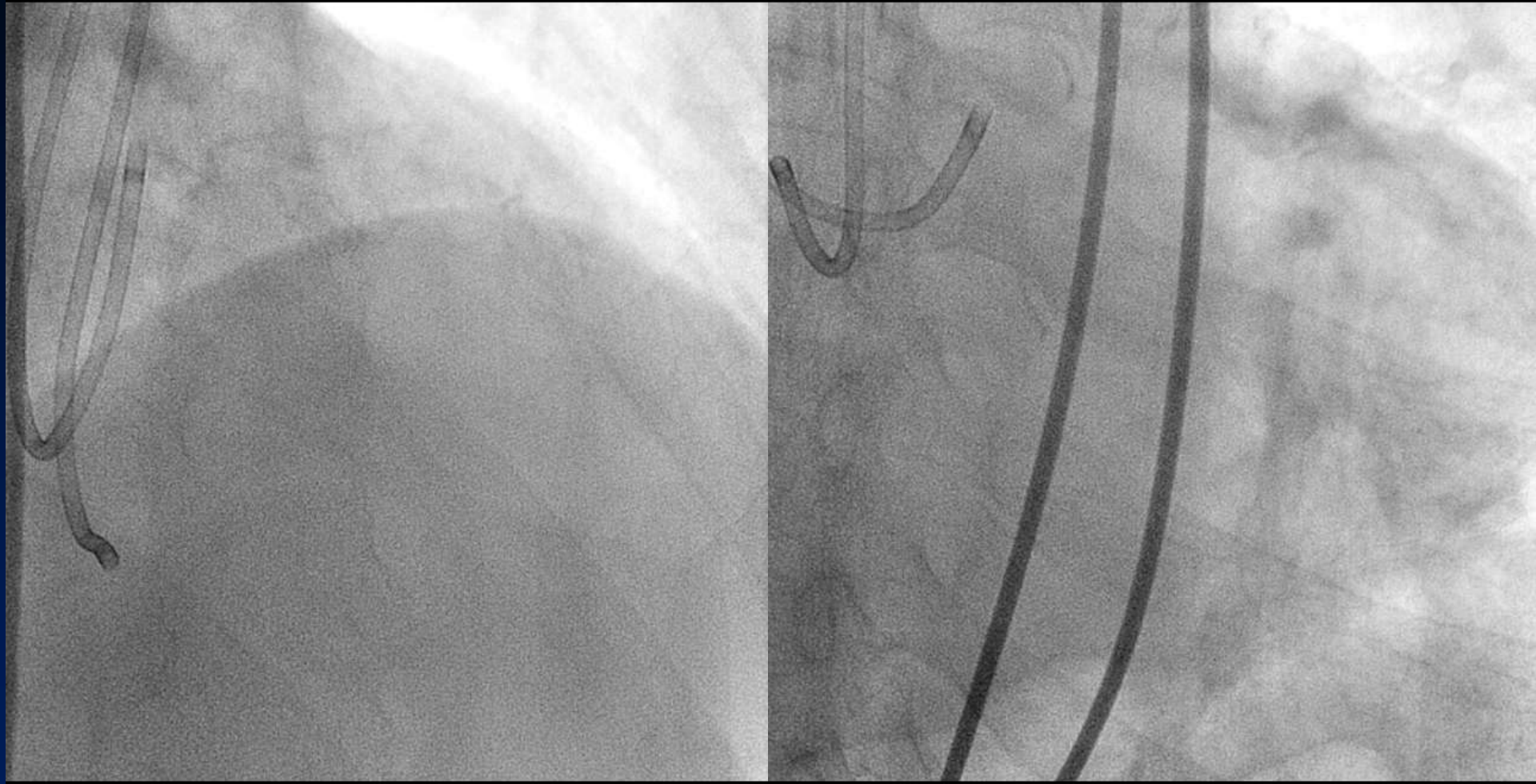
No!

What's the determinants?

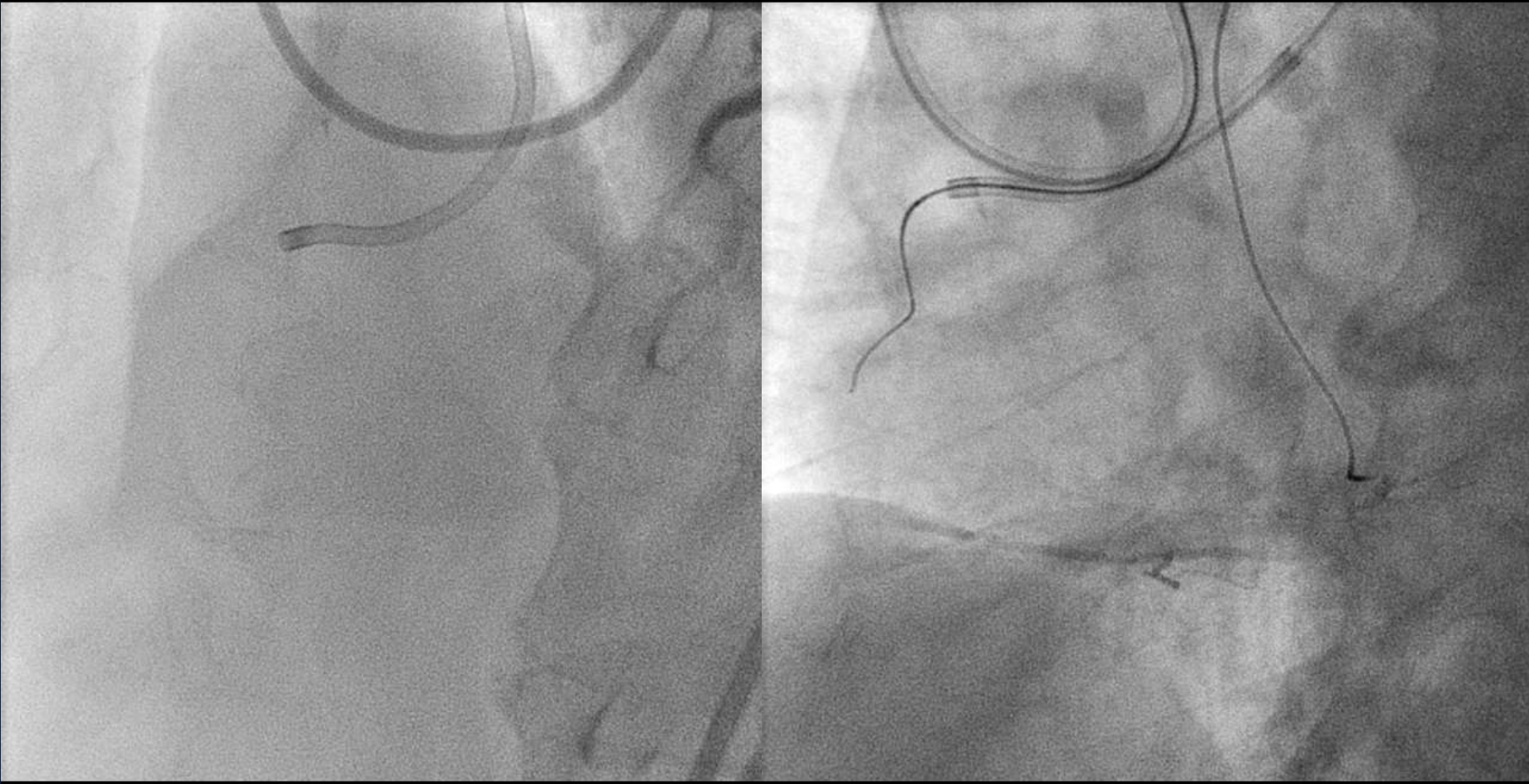
Age, Territory size, and Clinical condition



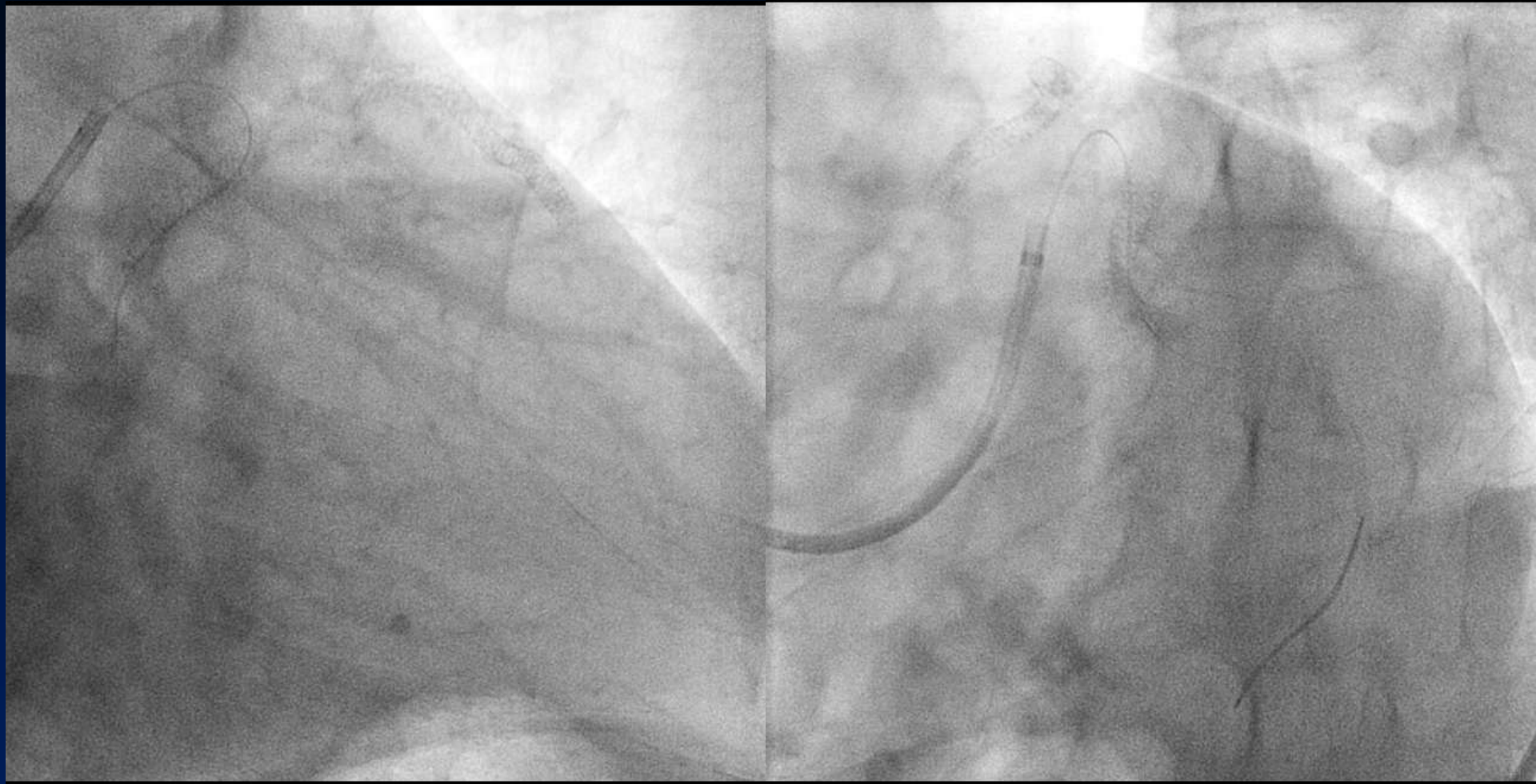
TVD with RCA-CTO



TVD with RCA-CTO



TVD with RCA-CTO

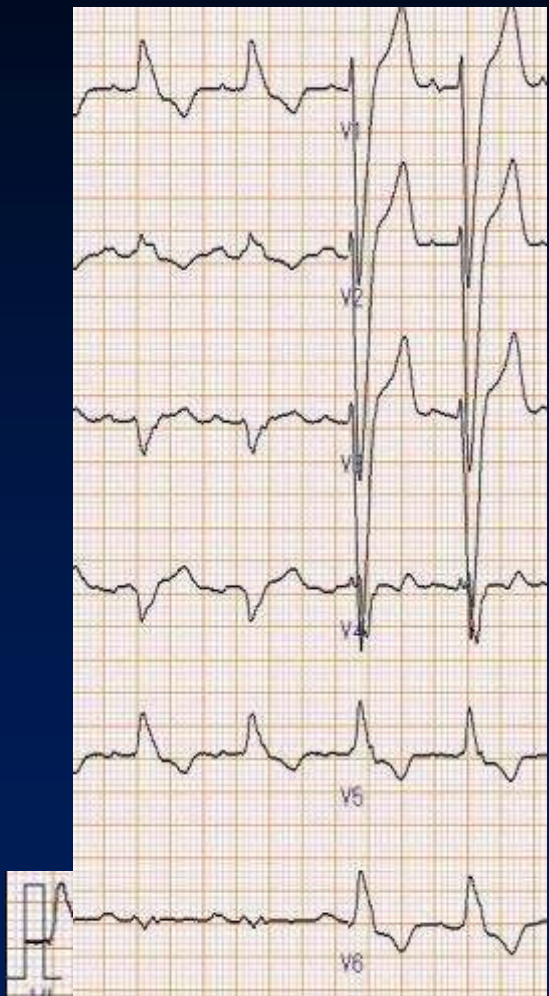


75yo, CHF, AP, CKD

2013/11/14

ECG

Chest XP



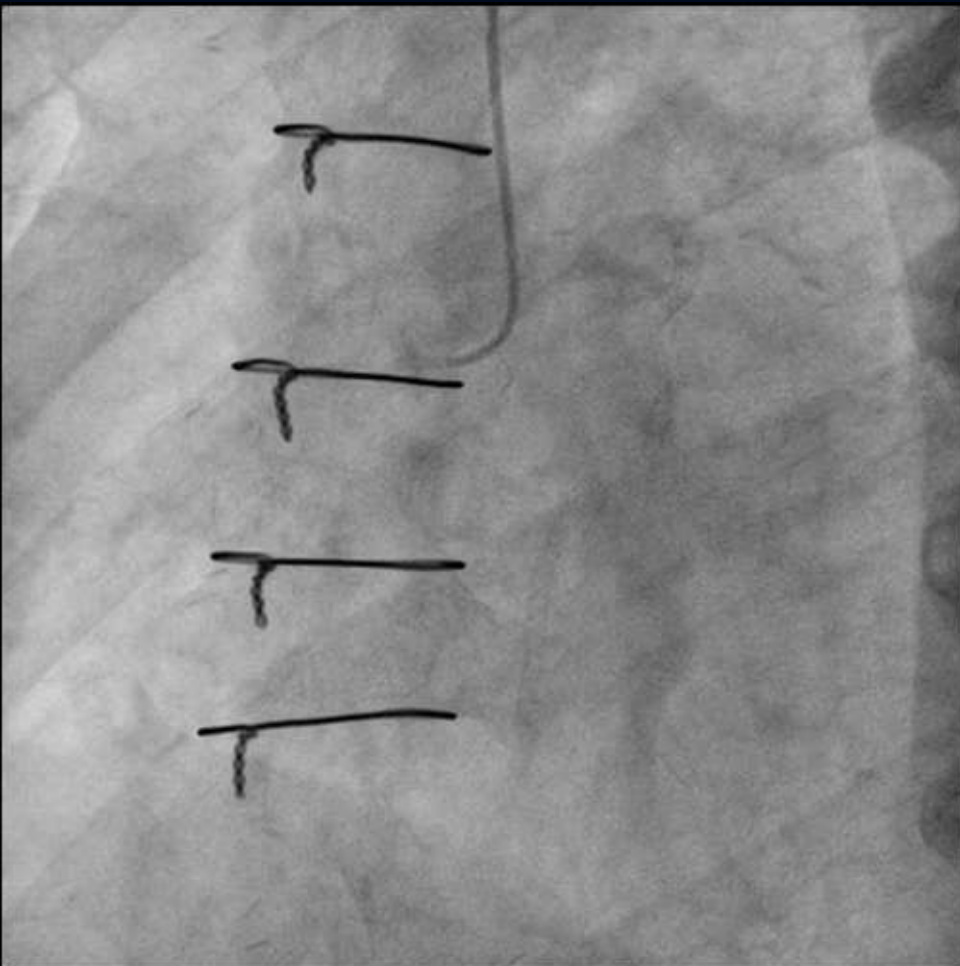
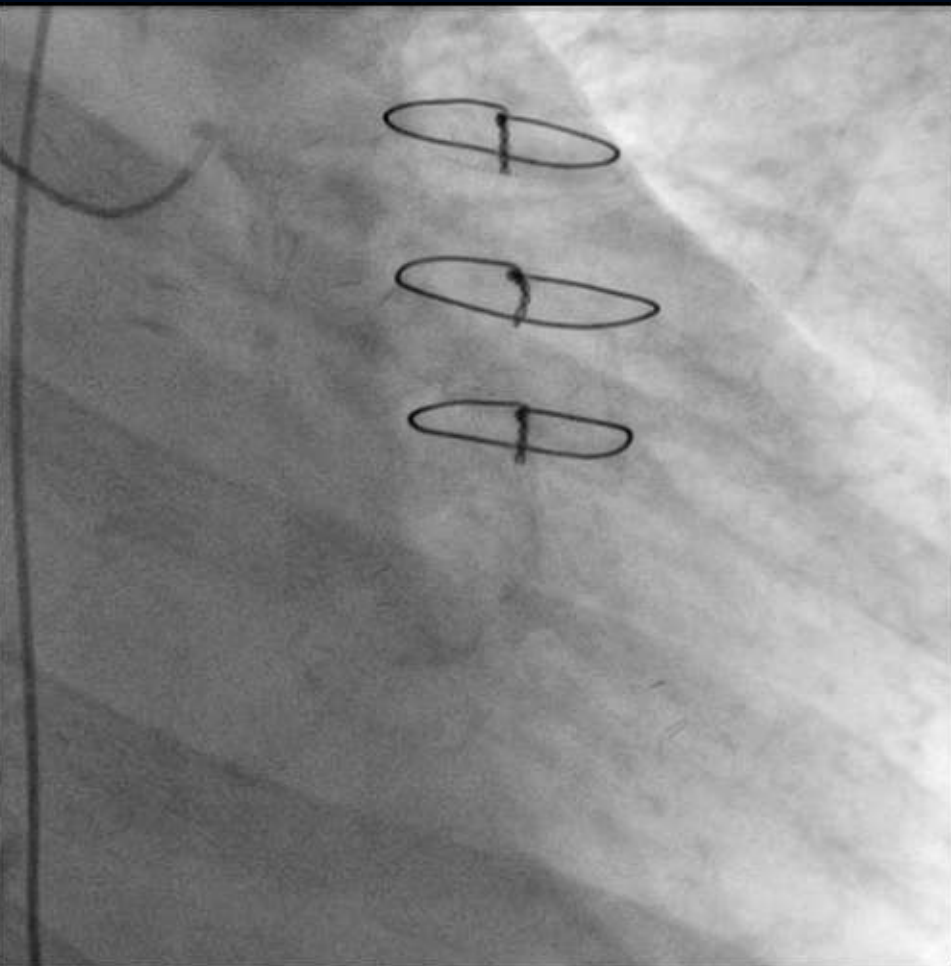
HR 90 nsr
CLBBB
QRS
180msec



CTR 68%

CAG

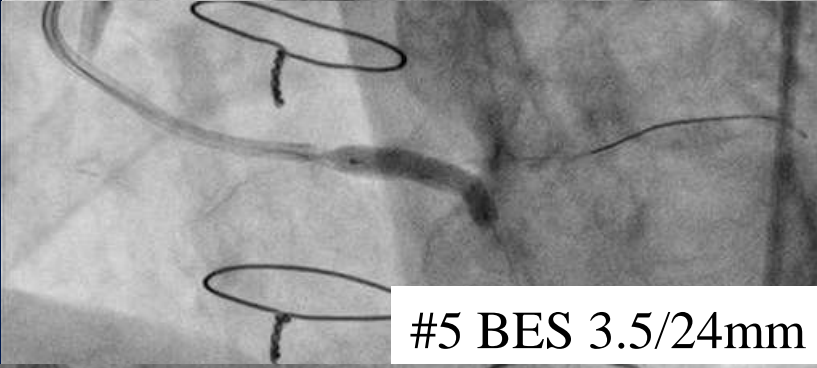
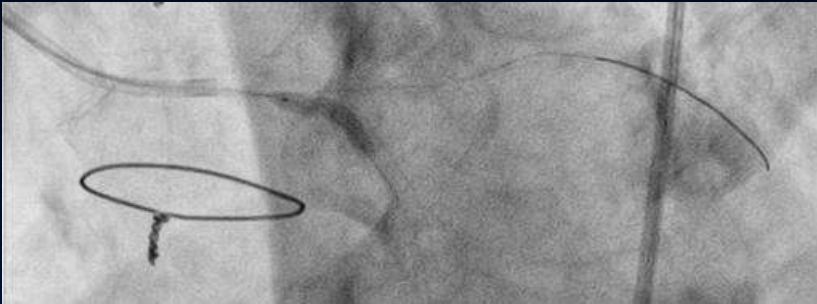
2013/11/28



1st PCI (for LMT)

2013/12/6

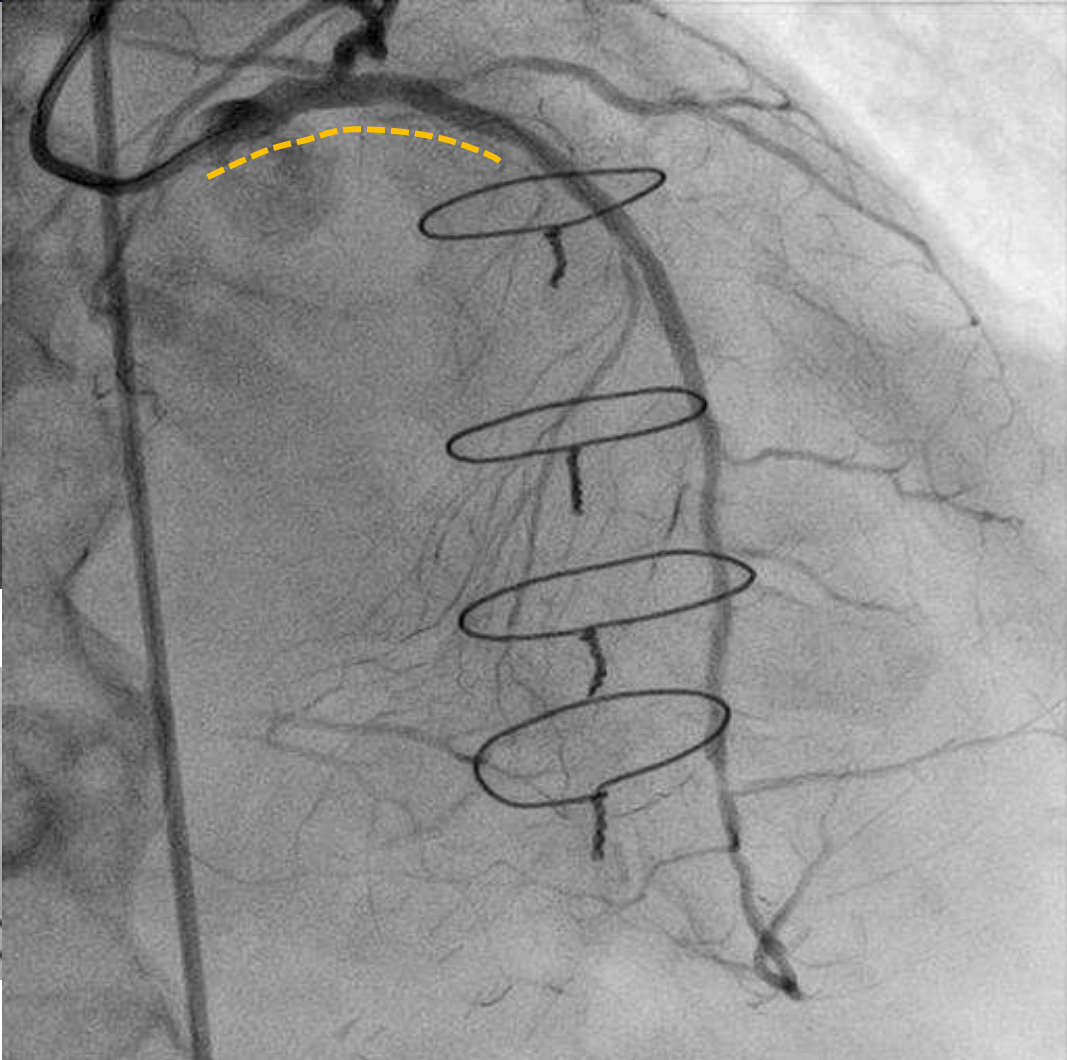
Lt.TFI 6F



#5 BES 3.5/24mm



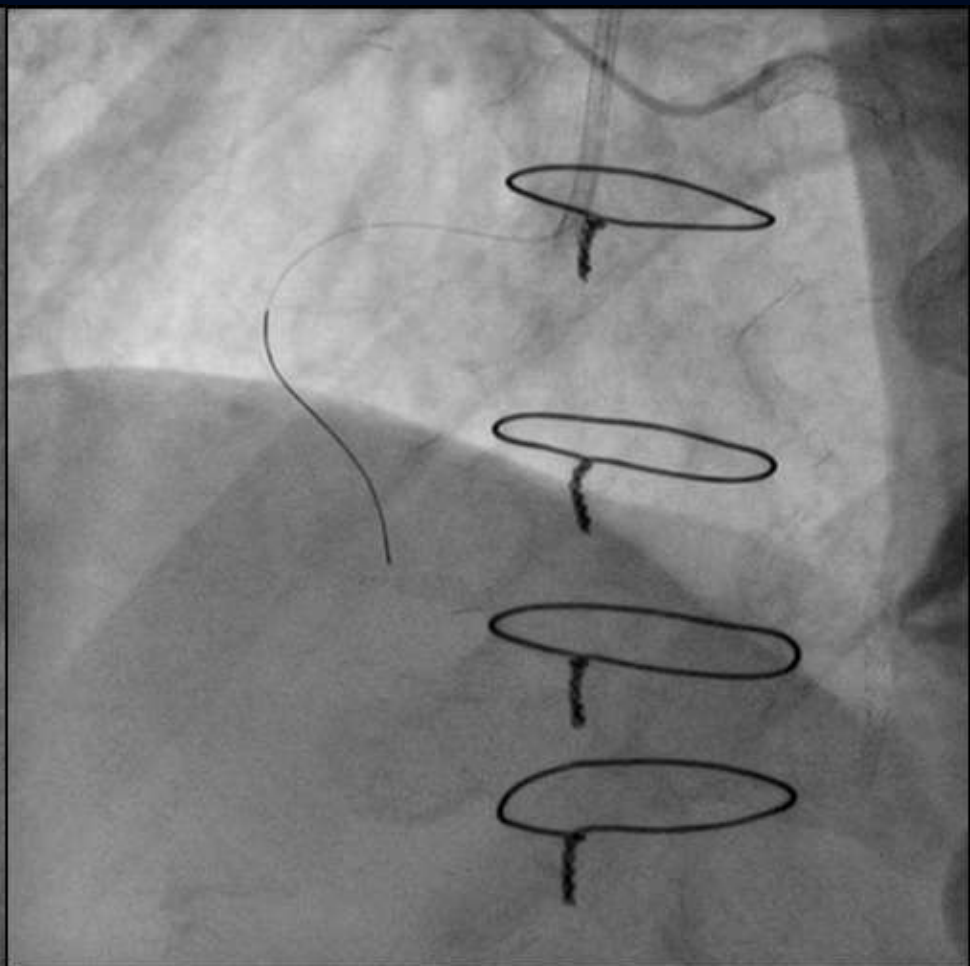
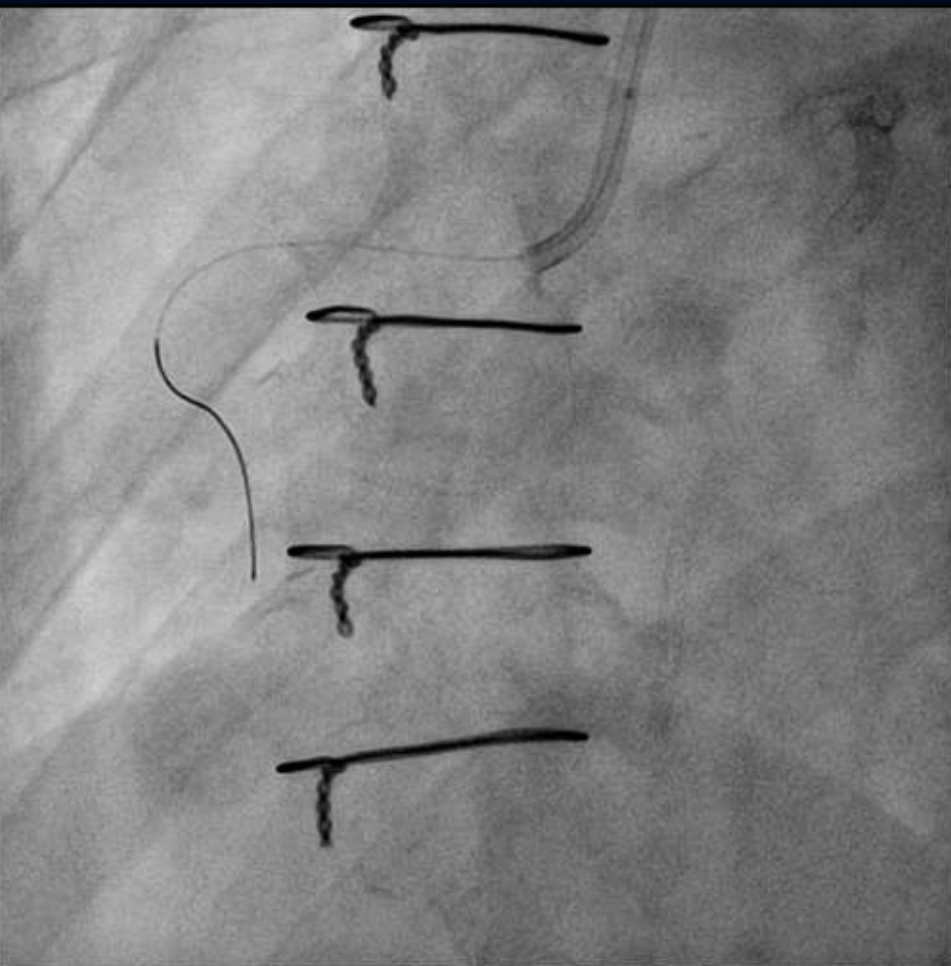
#6 BES 3.5/12mm



2nd PCI (for RCA-CTO)

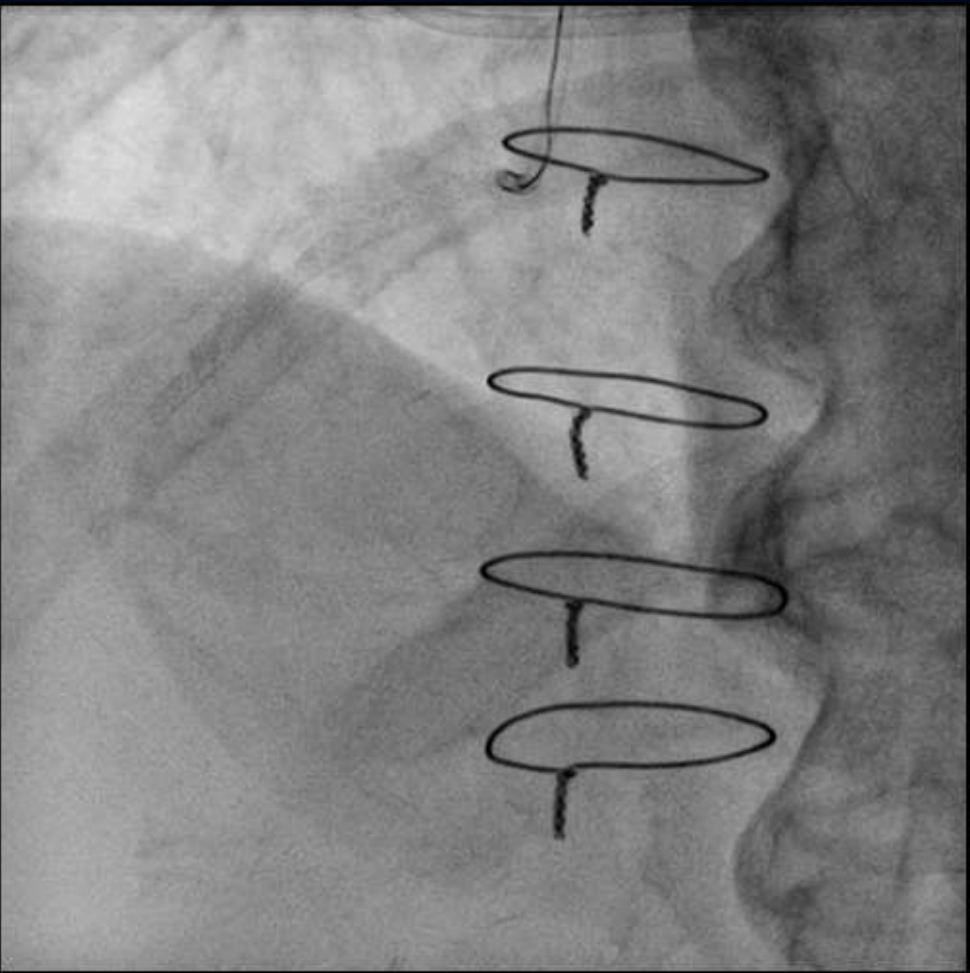
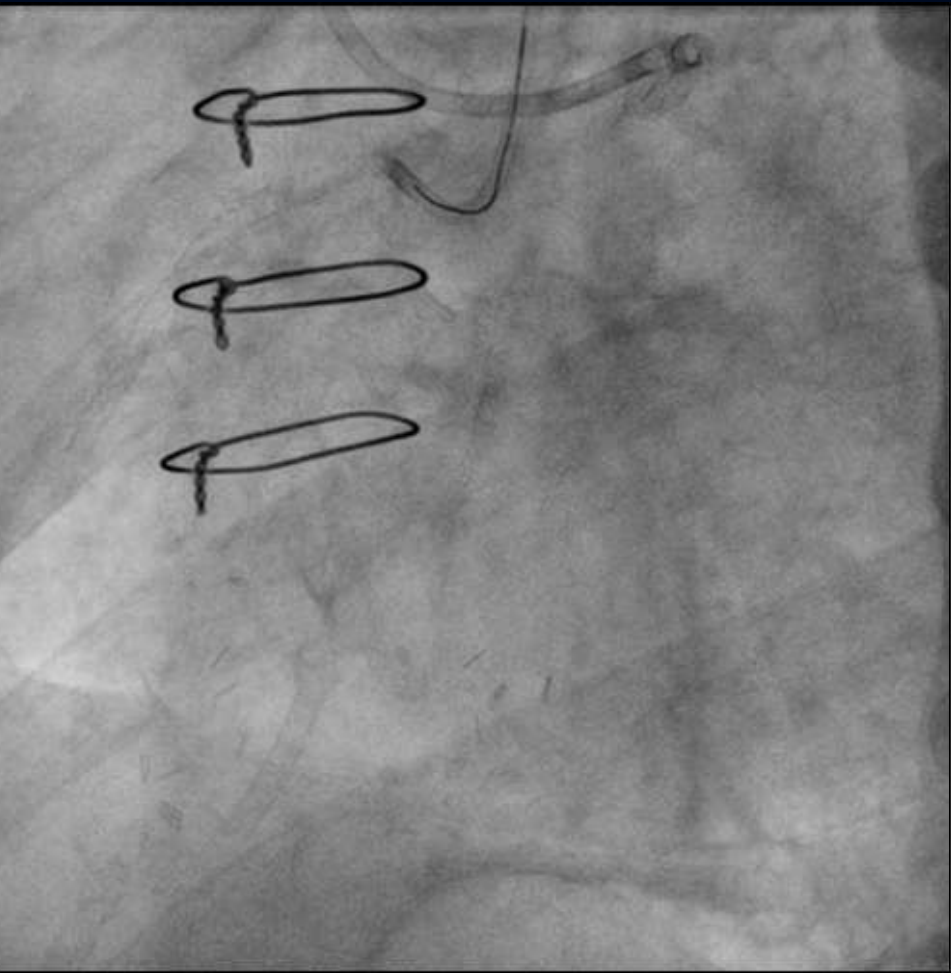
2013/12/27

Bil.TFA7F: CLS 3.5,



Final CAG

Contrast 108ml fluoroscopic time 144min

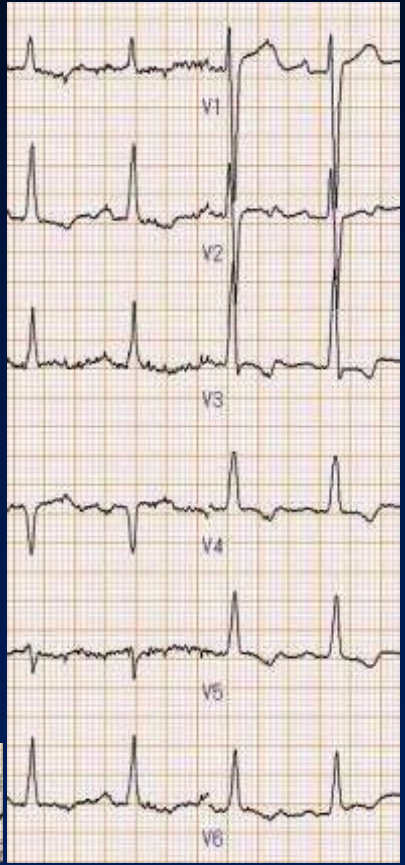
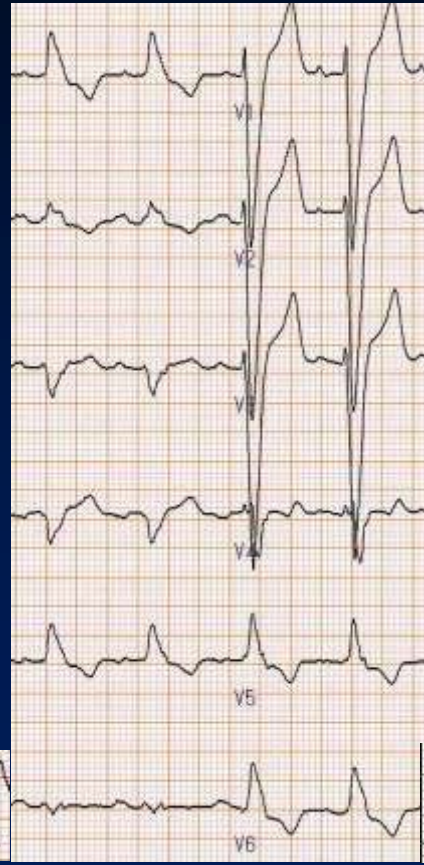


Post PCI...

ECG

2013.11

2014.3



QRS 180msec

QRS 120msec

Chest XP

2013.11

2014.3



CTR 68%

CTR 55%

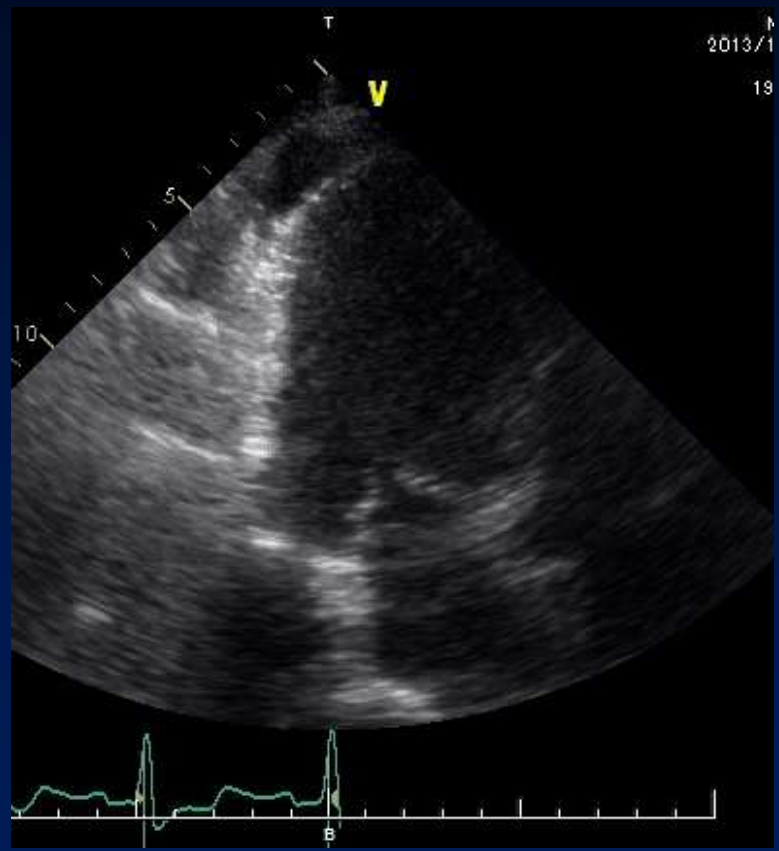
Renal function

	2013.11	Post PCI	2014.3
Cr	1.6	2.9	1.8

Post PCI...

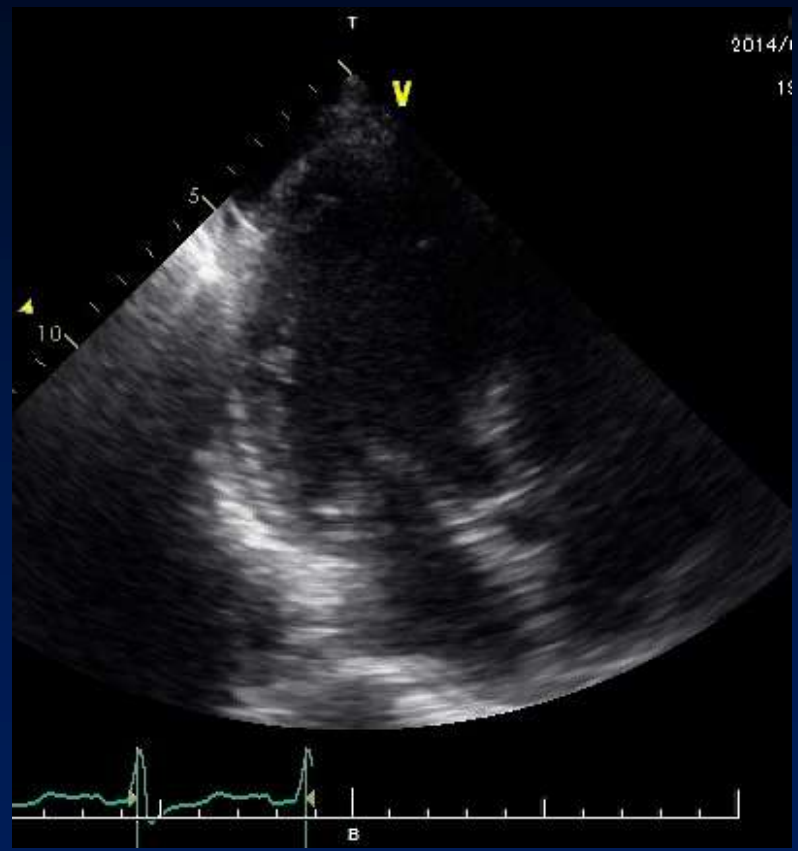
TTE

2013.11



EF 18%

2014.1



EF 30%



Essences of PCI of CTOs

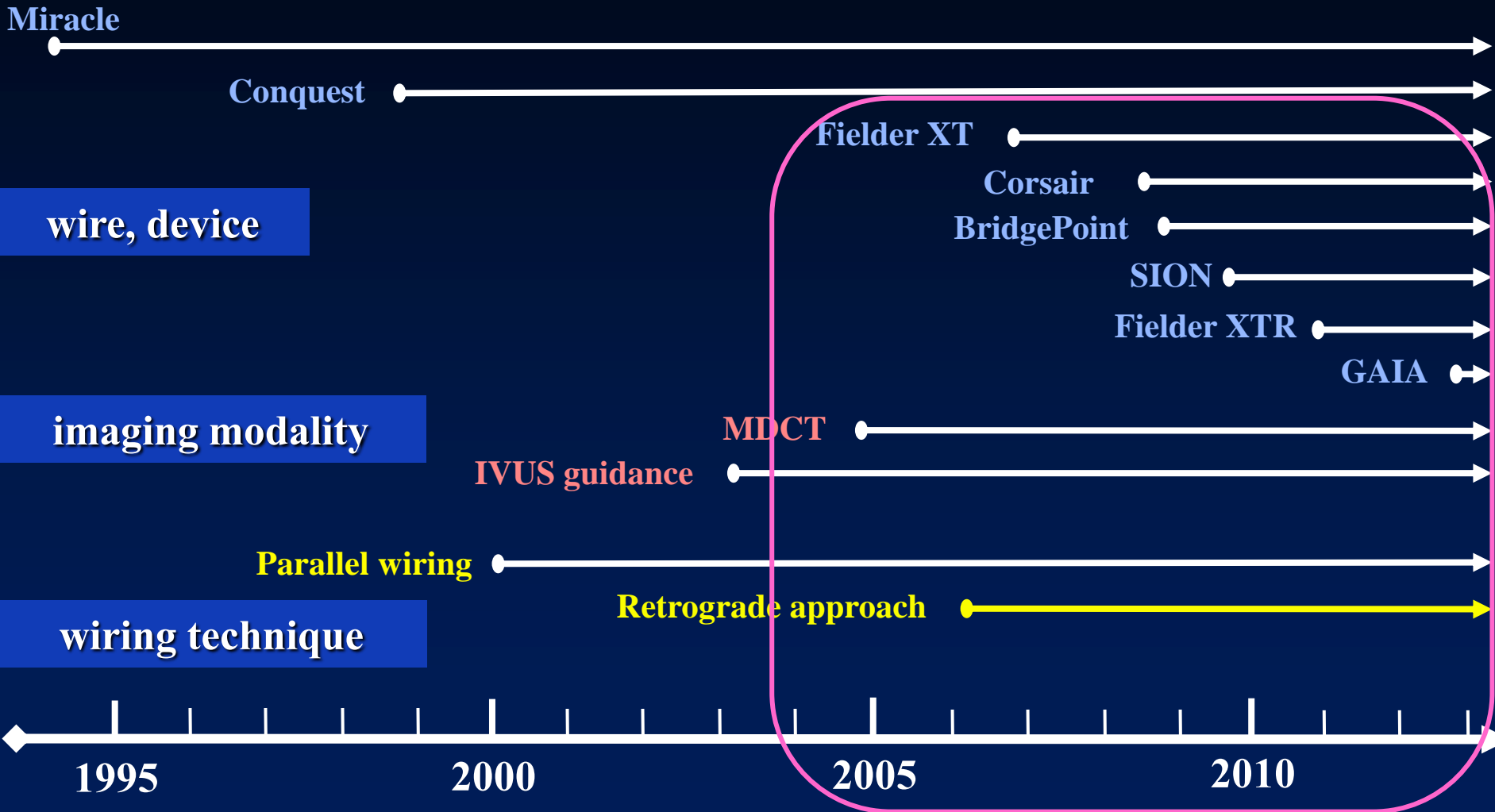
1. Why?

2. When?

3. How?

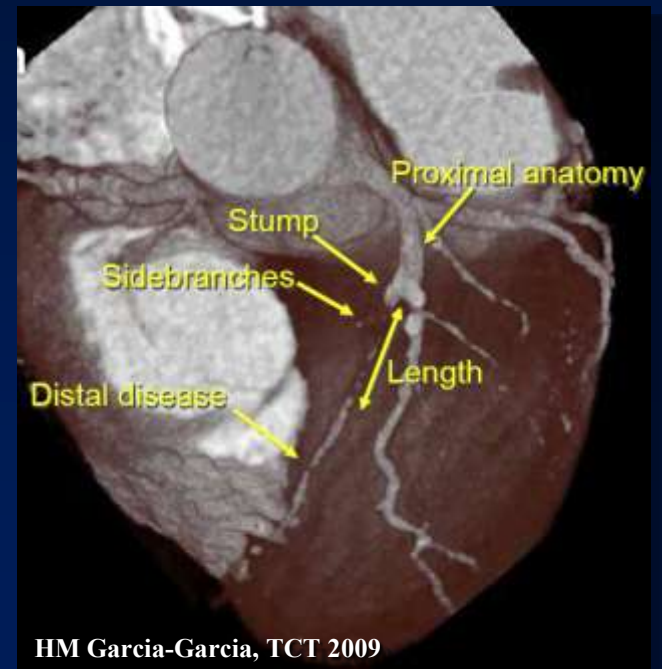
4. Who?

Development of CTO-PCI procedure



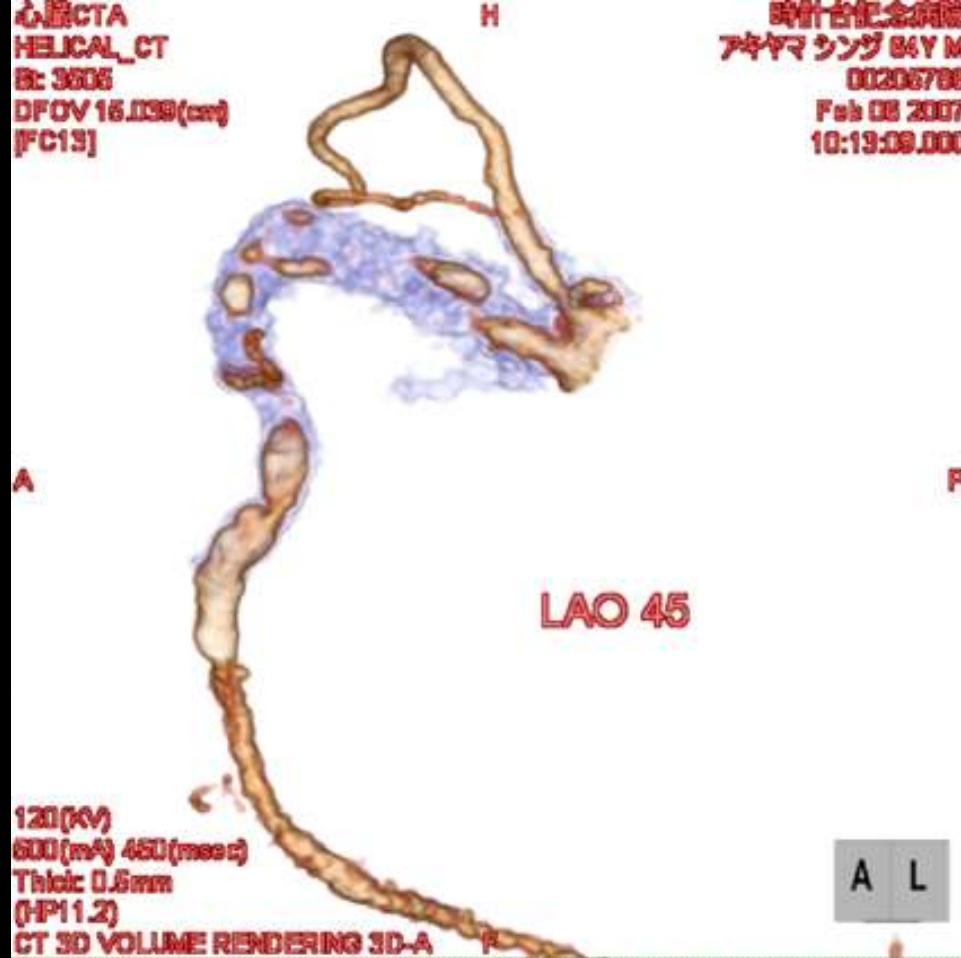
Morphological Information by MDCT

- Location of the both ends of the occluded site
- Distal flow (through collateral vessel)
- Vessel trajectory (bending / tortuosity)
- Stump sign
- Calcium distribution
- Vessel size (remodeling pattern)
- Occlusion length

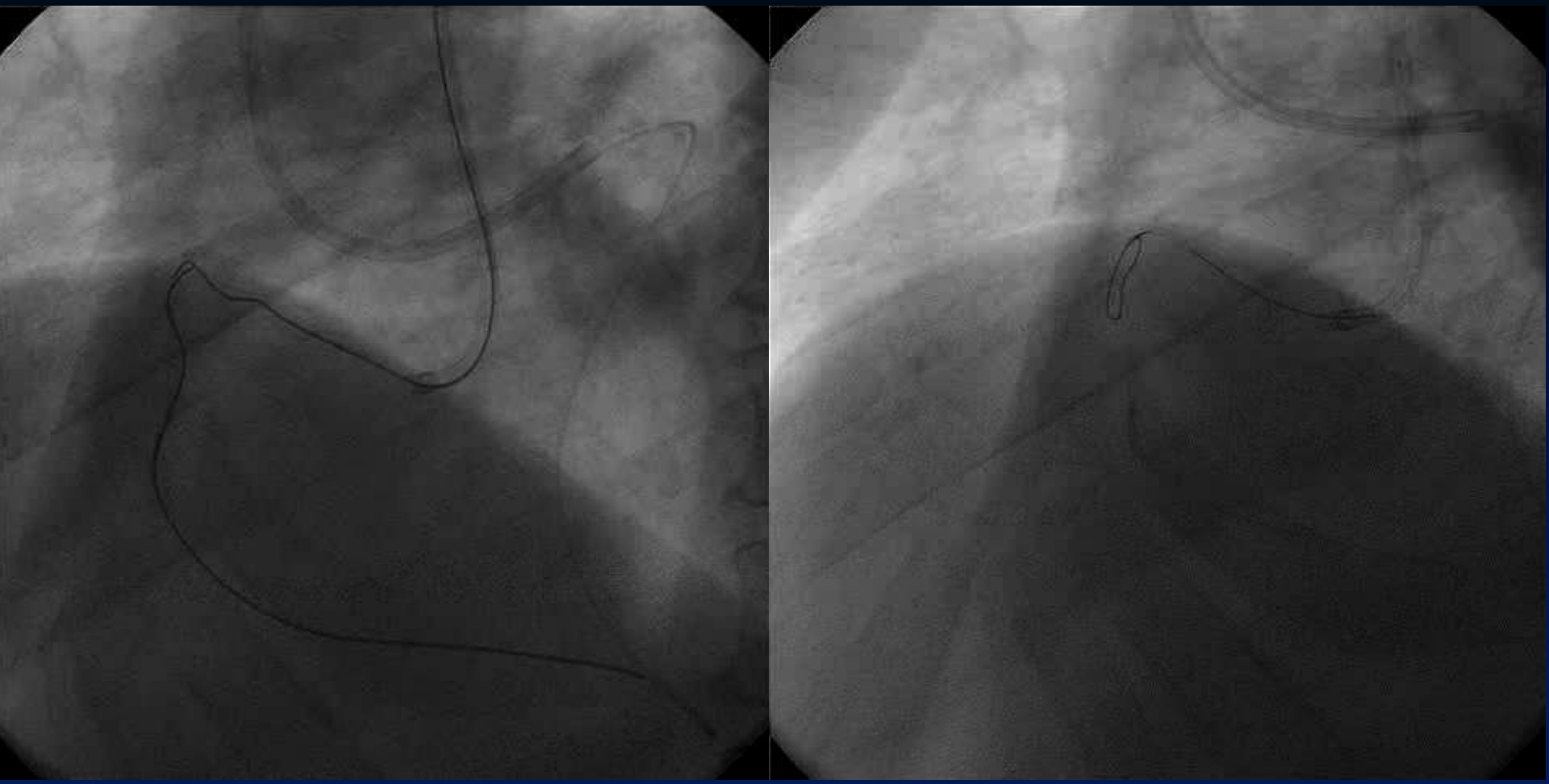


HM Garcia-Garcia, TCT 2009

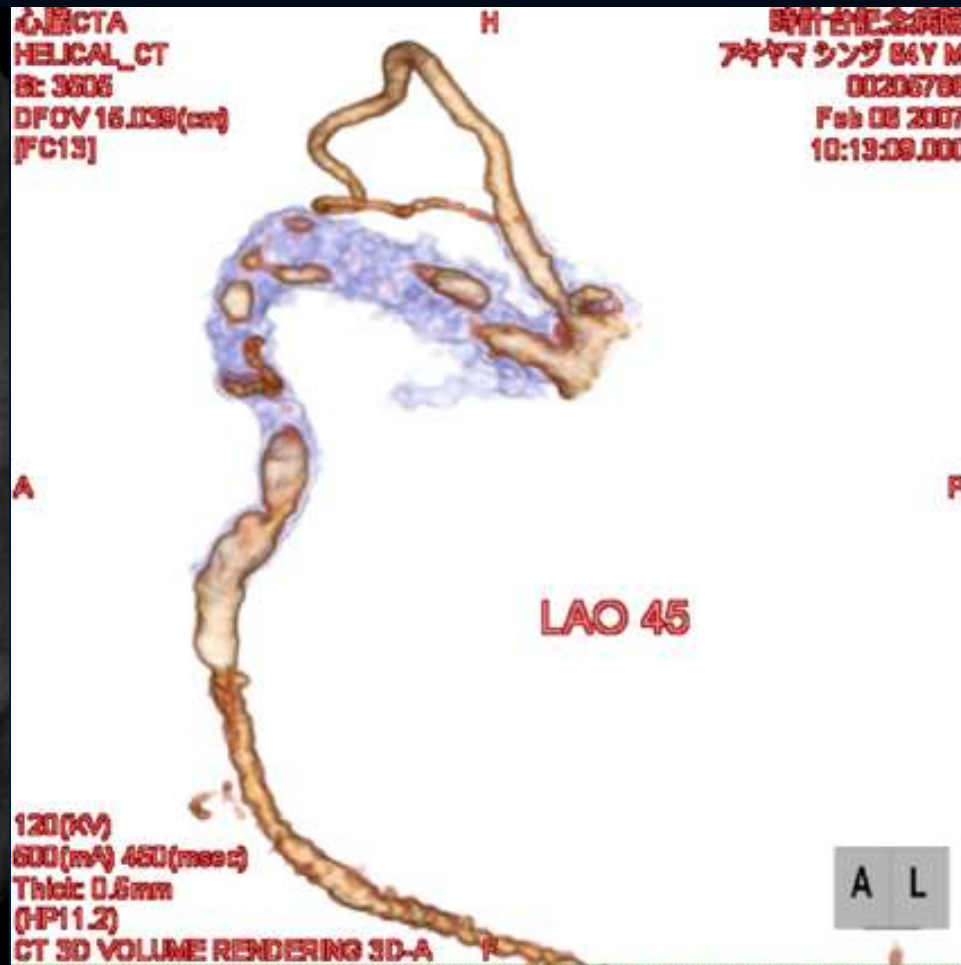
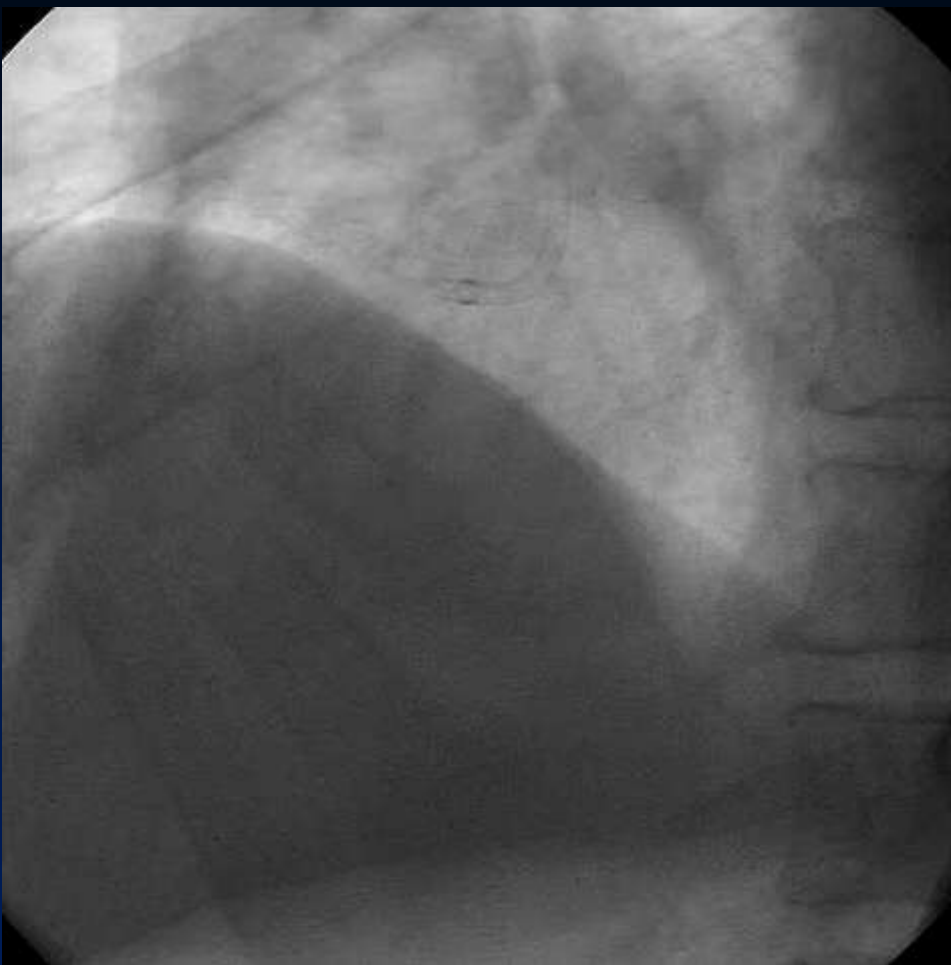
RCA-CTO: unknown trajectory



Pre CAG and MDCT



Bilateral wiring and reverse CART





An Assortment of Technical Tips in Antegrade Wiring

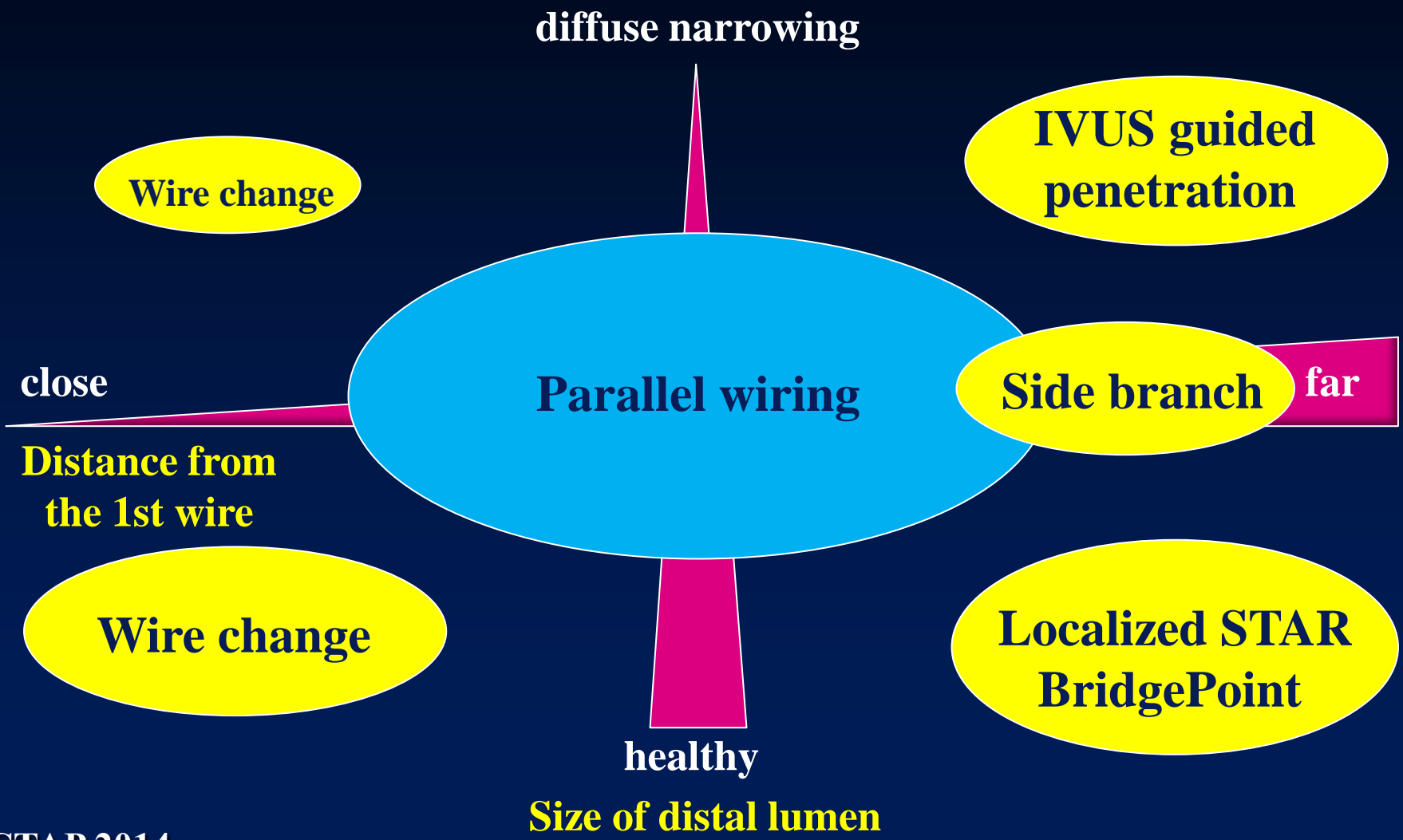
1. Single wiring

- **MSCT**
- **Loose tissue or micro channel tracking**
- **Corsair / Crusade support**
- **Step down strategy**
- **Balloon anchoring**
- **IVUS confirmation of CTO entry**
- **Side branch technique**

2. After subintimal tracking by the 1st wire

- **Parallel wiring**
- **Localized STAR**
- **Bridge Point device**
- **IVUS guided penetration**

Antegrade Strategies When the 1st Wire Is Subluminal





Standard Retrograde Approach with Channel Dilator

1. Collateral channel tracking



2. Advancement of **channel dilator**



3. Retrograde wire cross or reverse CART (w/wo IVUS)



4. Externalization of **3m wire**



5. Antegrade balloon/stent though the reversed **3m wire**

Latest Annual Report from 2012 Registry by **Retrograde Summit**

(ACC2014)

Enrollment

Registered Hospitals (in order with entry number)

Sakurabashi Watanabe Hospital	103	Kushiro City General Hospital	27
Saiseikai Yokohamashi Tobu Hospital	102	Nagoya Daini Red Cross Hospital	27
Toyohashi Heart Center	90	Yotsuba Circulation Clinic	27
Sapporo Cardio Vasc			25
Saitama Cardiovascu			24
Takase Clinic			23
Saitama Sekishinkai			22
The Cardiovascular I			22
Higashi Takarazuka			21
Shinkoga Hospital			20
Sanda City Hospital			18
Seirei Hamamatsu G			16
Nagoya Heart Center			16
Edogawa Hospital			15
Nagoya Tokushukai			13
Hokkaido Social Insu			13
Shiga Medical Center for Adults	35	Tokushima Red Cross Hospital	13
Hoshi General Hospital	33	Iwate Prefectural Central Hospital	9
Kakogawa East City Hospital	30	Hokusetsu General Hospital	8
Hokko Memorial Hospital	30	Toho University Omori Medical Center	3
Kyoto Katsura Hospital	29	Osaki Citizen Hospital	2
Kusatsu Heart Center	29	Other	1

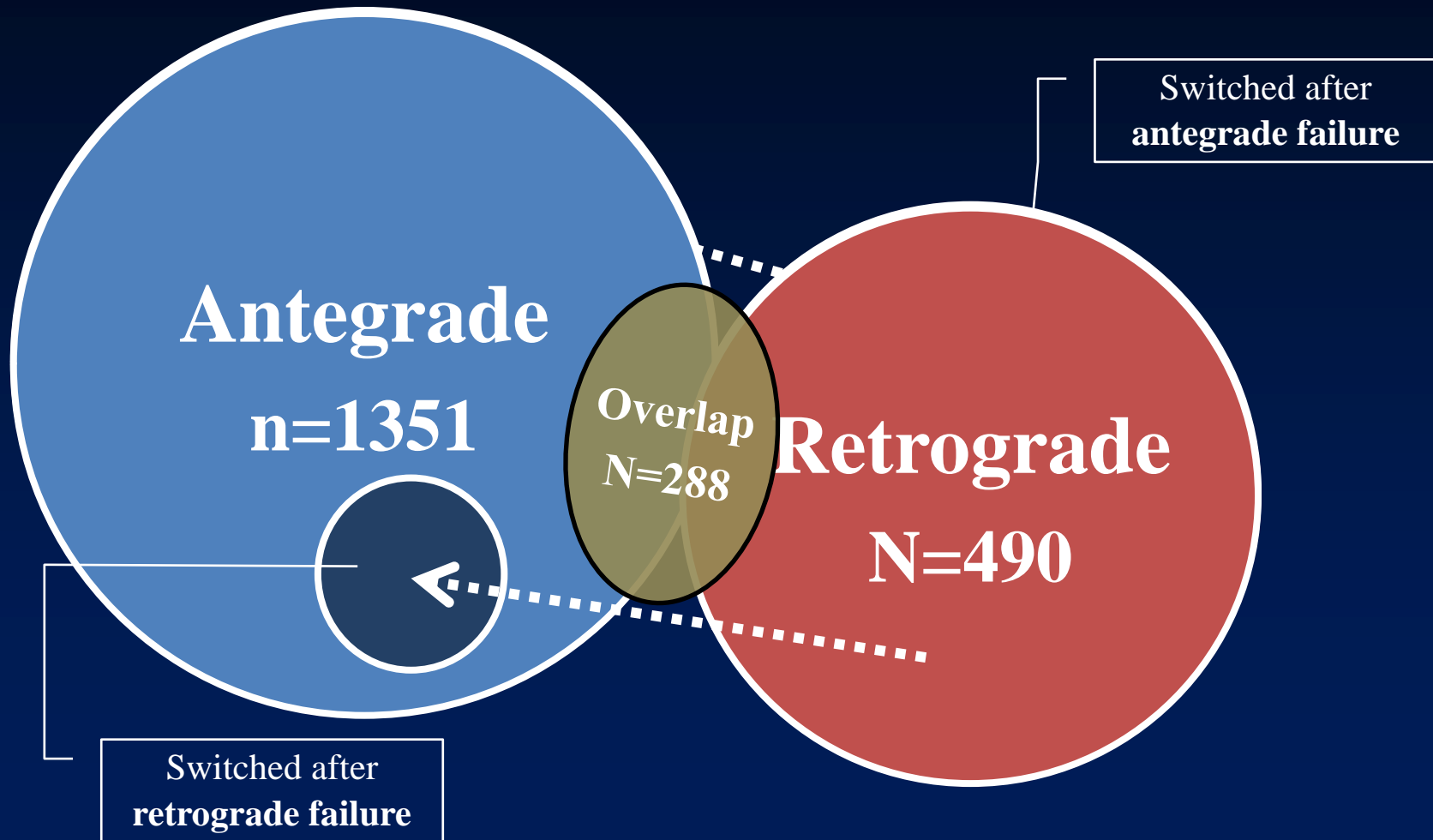
Jan 2012 – Dec 2012

The number of registry : 1553

Registered Hospital : 44

Registry Data: Jan - Dec 2012

CTO-PCI (n=1553)




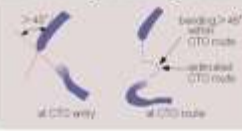
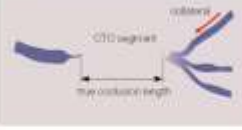


Procedure outcome in 2012

(Antegrade & Retrograde)

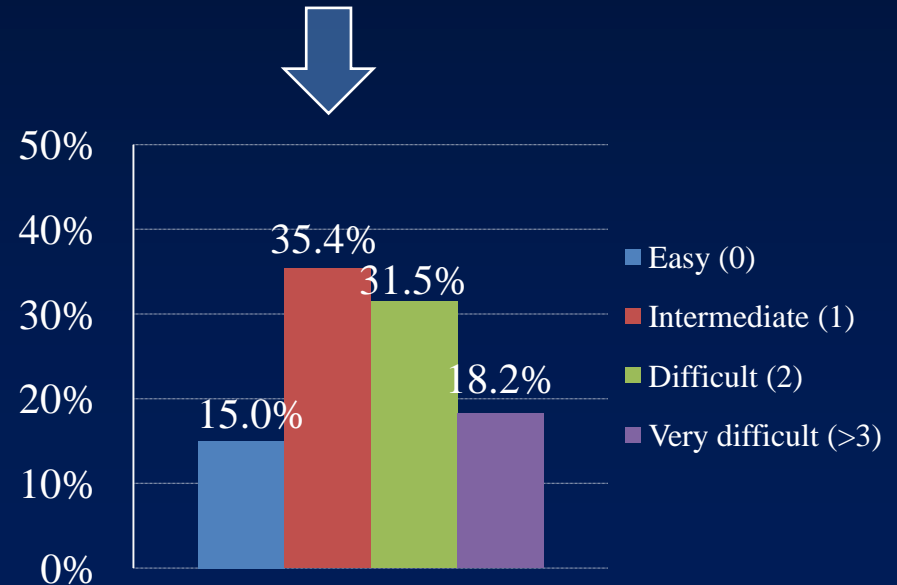
	Total (1553)
Successful CTO crossing by guidewire	89.6%
Number of guidewire used for CTO approach	3.3 ± 2.3
Number of stent	1.9 ± 0.9
Procedure success	88.3%
Procedure time, min	142.6 ± 83.4
Contrast dose, ml	228.7 ± 107.2
Fluoroscopy time, min	64.2 ± 42.4
Air Kerma, mGy	4,716 ± 3,761

J-CTO score

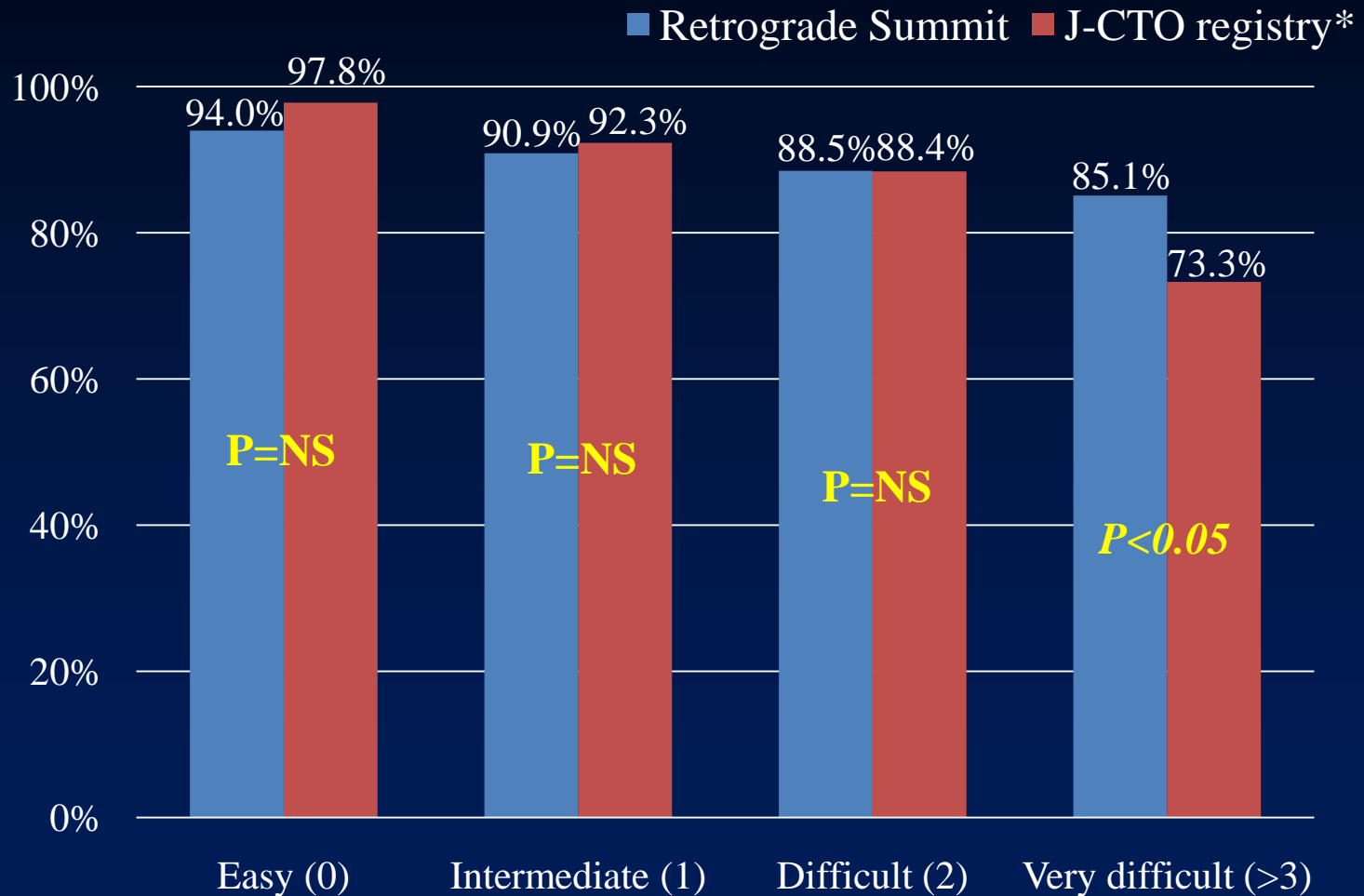
J-CTO SCORE SHEET		Version 1.0
Variables and definitions		
<p>Tapered</p> 	<p>Blunt</p> 	<p>Entry with any tapered tip or dimple indicating direction of true lumen is categorized as "tapered".</p>
		<p>Entry shape</p> <input type="checkbox"/> Tapered (0) <input type="checkbox"/> Blunt (1)
		point
<p>Calcification</p> 	<p>Regardless of severity, 1 point is assigned if any evident calcification is detected within the CTO segment.</p>	<p>Calcification</p> <input type="checkbox"/> Absence (0) <input type="checkbox"/> Presence (1)
		point
<p>Bending > 45degrees</p> 	<p>One point is assigned if bending > 45 degrees is detected within the CTO segment. Any tortuosity separated from the CTO segment is excluded from this assessment.</p>	<p>Bending > 45°</p> <input type="checkbox"/> Absence (0) <input type="checkbox"/> Presence (1)
		point
<p>Occlusion length</p> 	<p>Using good collateral images, try to measure "true" distance of occlusion, which tends to be shorter than the first impression.</p>	<p>Occl.Length</p> <input type="checkbox"/> < 20mm (0) <input type="checkbox"/> ≥ 20mm (1)
		point
<p>Re-try lesion</p> <p>Is this Re-try (2nd attempt) lesion ? (previously attempted but failed)</p>		<p>Re-try lesion</p> <input type="checkbox"/> No (0) <input type="checkbox"/> Yes (1)
		point
<p>Category of difficulty (total point)</p> <input type="checkbox"/> easy (0) <input type="checkbox"/> Intermediate (1) <input type="checkbox"/> difficult (2) <input type="checkbox"/> very difficult (>3)		<p>Total</p> <p>points</p>

- **Blunt tip/none or unclear tip:** 53.7%
- **Calcification*:** 33.7%
- **Bending*:** 8.5%
- **Occlusion length > 20mm:** 61.7%
- **Re-try lesion:** 11.6%

**Score was counted based on judgment more than "moderate" grade for calcification and bending*



J-CTO score and GW success





Essences of PCI of CTOs

1. Why?

2. When?

3. How?

4. Who?



**All interventional cardiologist should
touch CTOs?**

No!

What's the determinants?

Experience

Sub Analysis from 2012 Registry

Impact of Operator Experience on Procedural Results

Enrollment (Jan – Dec 2012)

- Total 1553 CTO procedure
- Registered hospital : **44**

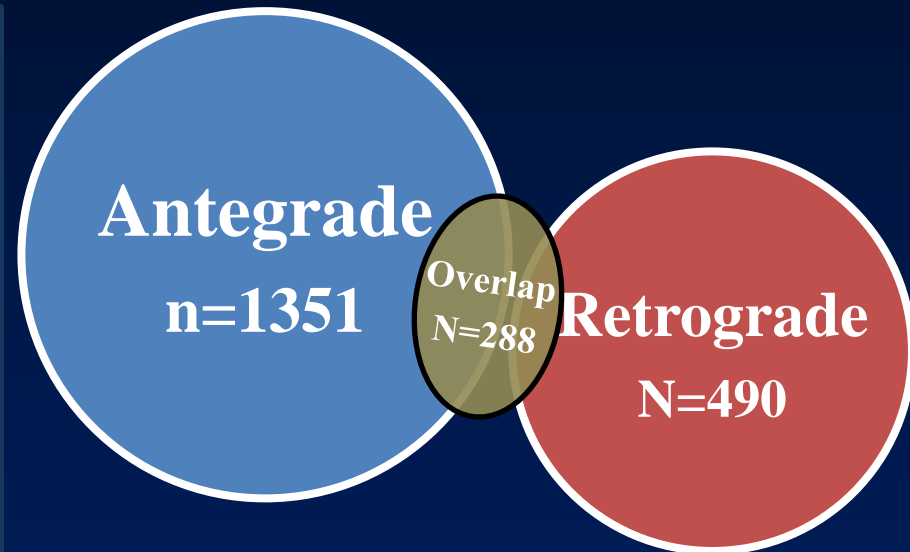
CTO-PCI 1553

- Higher volume center (HC)

There is one or more operator with estimated CTO-PCI volume ≥ 50 per year* --- **17** center
(* Including oversea cases)

- Lower volume center (LC)

There is not such higher volume operator --- **27** center



Lesion characteristics (1)

	HC (967)	LC (586)	P value
Re-attempt	12.3%	10.4%	0.2554
Previous strategy			
- Antegrade	82.1%	75.0%	0.1114
- Retrograde	4.3%	0%	
- Both	9.4%	15.0%	
- NA	4.3%	10.0%	
Previous failure reason			
- Failure to cross CTO by GW	88.0%	86.7%	0.3104
- Failure to cross collateral by GW	0%	3.3%	
- Delivery failure of treatment device	5.0%	5.0%	
- NA	7.0%	5.0%	

Lesion characteristics (2)

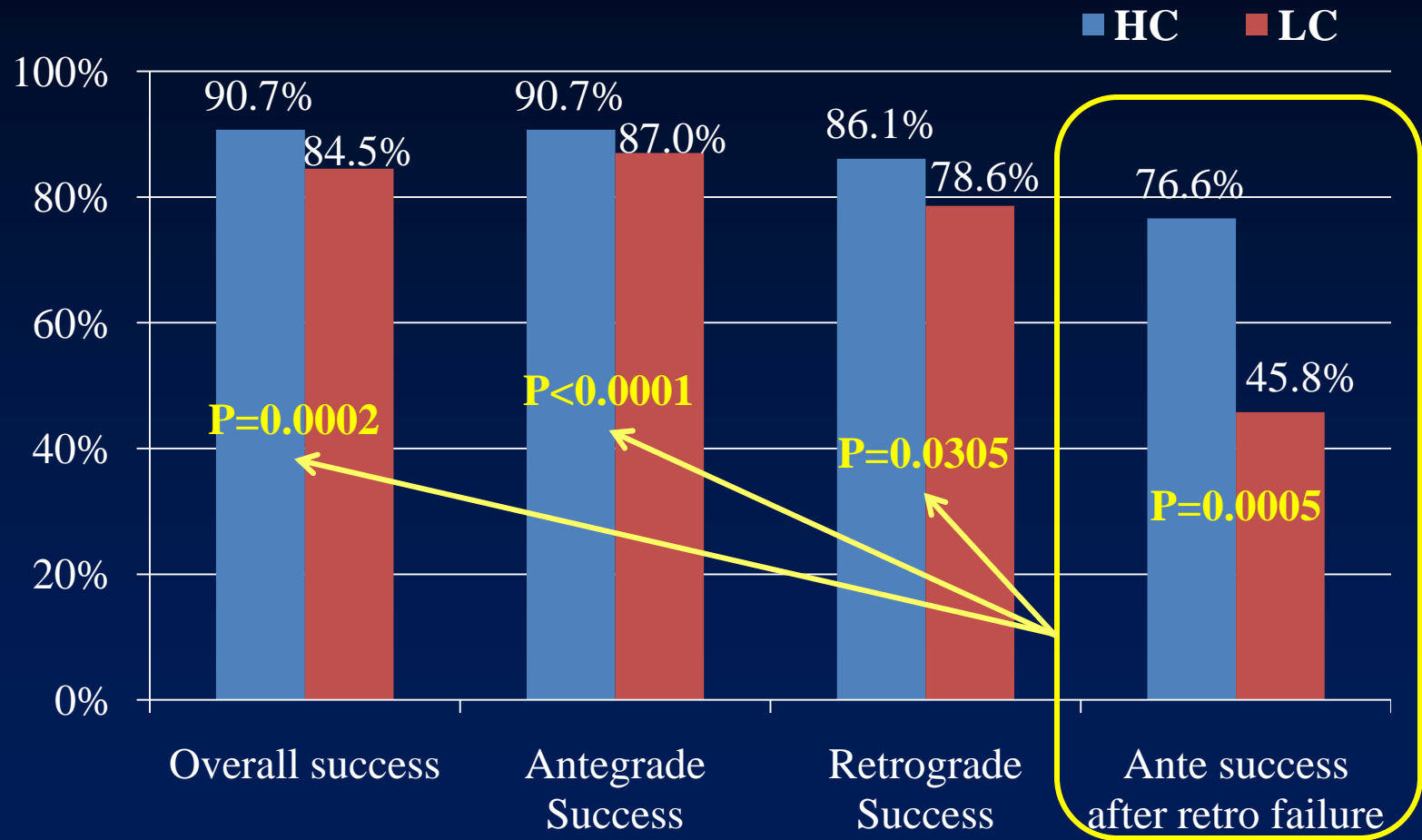
	HC (967)	LC (586)	P value
Target vessel			
- RCA	46.6%	46.4%	0.9419
- LAD	32.0%	31.6%	
- LCx	21.1%	21.8%	
- LMT	0.3%	0.2%	
Reference diameter	2.9±0.5	3.1±1.6	0.1009
Occlusion length	25.7±16.4	25.7±18.2	0.9283
ISR-CTO	14.5%	15.1%	0.7587
Occlusion period			
- ≥ 1 year	7.8%	9.6%	0.0044
- < 1 year	7.4%	11.8%	
- Unknown	84.9%	78.7%	
Collateral filling grade			
- CC 0	8.5%	11.3%	0.2449
- CC 1	58.9%	55.9%	
- CC 2	32.6%	32.9%	

Procedure outcome (1)

	HC (967)	LC (586)	P value
Successful CTO crossing by GW	91.6%	86.2%	0.0007
Number of GW used	3.3 ± 0.1	3.2 ± 0.1	0.3244
Procedure success	90.7%	84.5%	0.0002
Stent deployment	92.5%	94.1%	0.2662
Number of stent	1.9 ± 0.9	1.9 ± 0.9	0.5347
Total stent length, mm	51.8 ± 24.4	52.0 ± 25.7	0.8717
Use of drug-eluting stent	98.5%	97.2%	0.0952
Procedure time, min	134.5 ± 80.4	155.9 ± 86.6	<0.0001
Contrast dose, ml	235.7 ± 110.2	217.3 ± 101.3	0.0014
Fluoroscopy time, min	60.8 ± 39.6	70.1 ± 46.3	0.0001
Air Kerma, mGy	4589 ± 3834	4906 ± 3709	0.1772
MACCE	0.5%	1.0%	0.2483

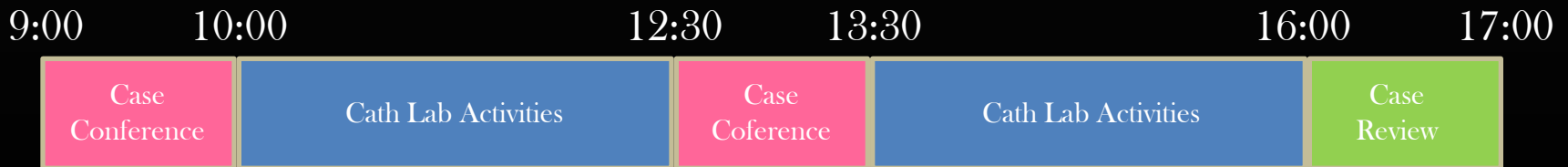
Comparison of Success Rate

High volume center vs. Low volume center



CTO Hands-on Workshop

- ◆ Proctorship mini-Live
- ◆ Operator from the next generation
- ◆ Audience from same generation
- ◆ Meticulous discussion before and after cases



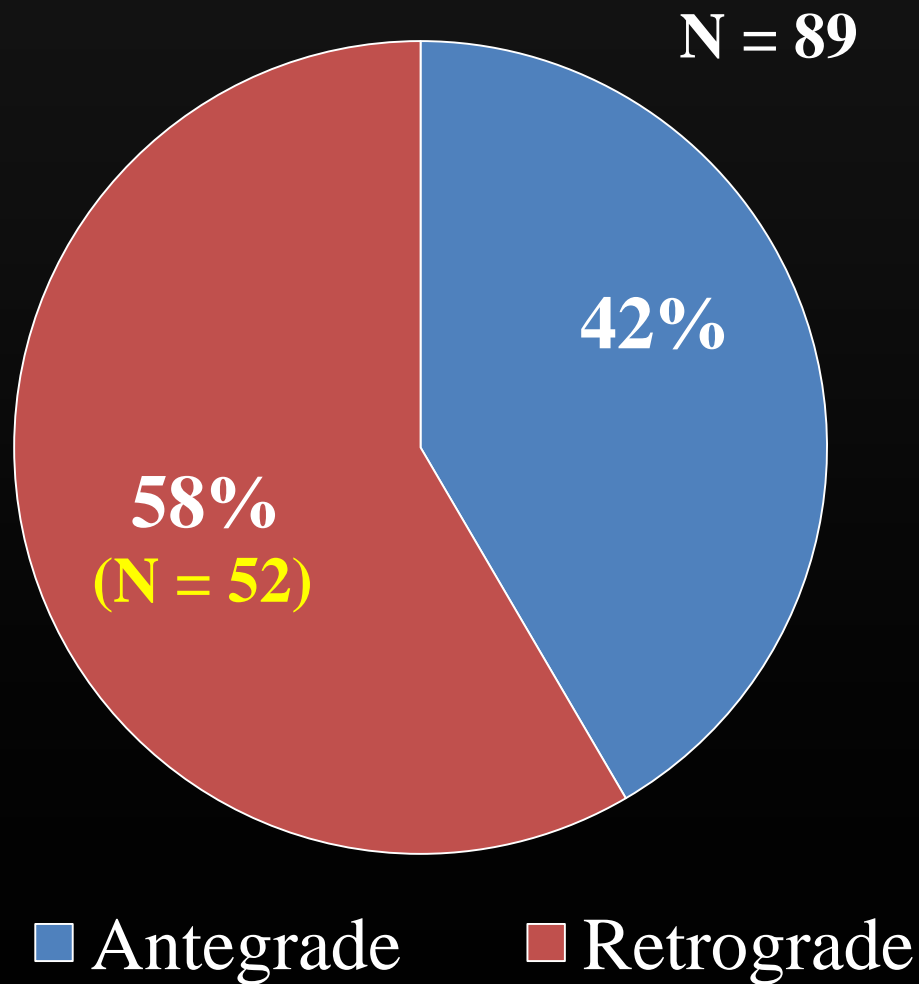
History of CTOHWS

(Since 2009)

- ✓ 51 times (2009.12~2014.2)
- ✓ Total number of audience
-798 Drs. (459 Drs.)
- ✓ Total number of CTO cases
-94 cases (proctor assisted in only 8 cases.)
- ✓ Success rate
-94.7% (89/94 cases)

CTO PCI Procedure

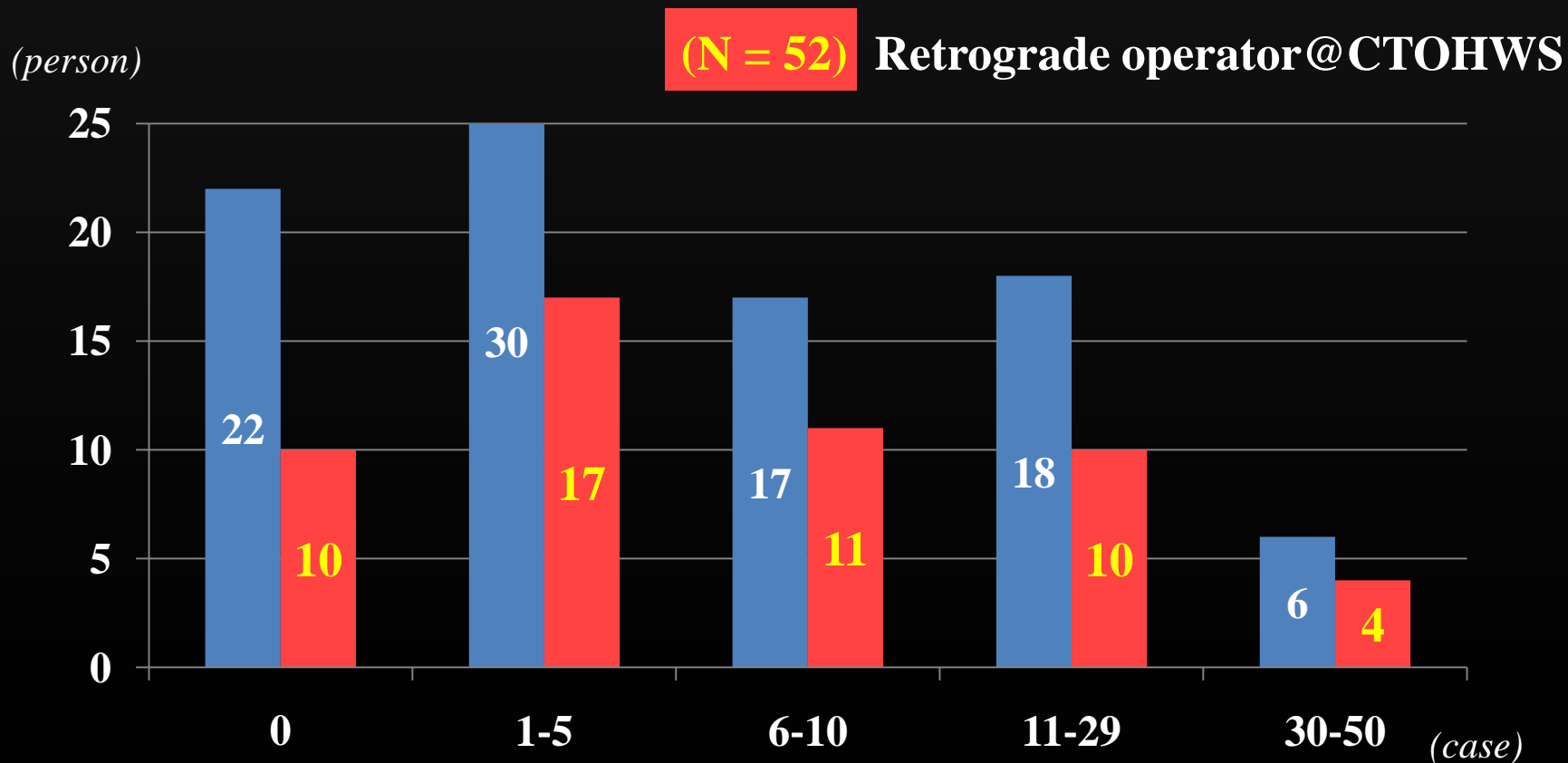
– GW Strategy –



Operator Background

~ Experience number of retrograde cases ~

8.7 ± 10.6 cases





Lessons from CTOHWS

- 1. No need of special hands for CTO-PCI**
- 2. Need of judgment to select appropriate tools and possible PCI techniques for the next step in each procedural situation.**
- 3. These abilities are built up by **experiences**.**
- 4. So we need **experiences** or to share **experiences** to be a good CTO operator.**



Essences of PCI of CTOs

- 1. Why? - To improve QOL and survival**
- 2. When? - Depended on age, territory size, and clinical conditions**
- 3. How? - Contemporary technology with dedicated devices**
- 4. Who? - Operator with many experiences, but no need of special hands**

15th CTO Club



June 20-21, 2014, Nagoya, Japan

www.cct.gr.jp/ctoclub