

OUTCOMES OF APCTO 2016 CTO REGISTRY AND PERSPECTIVES

Dr Eugene B Wu... On behalf of APCTO club
directors.

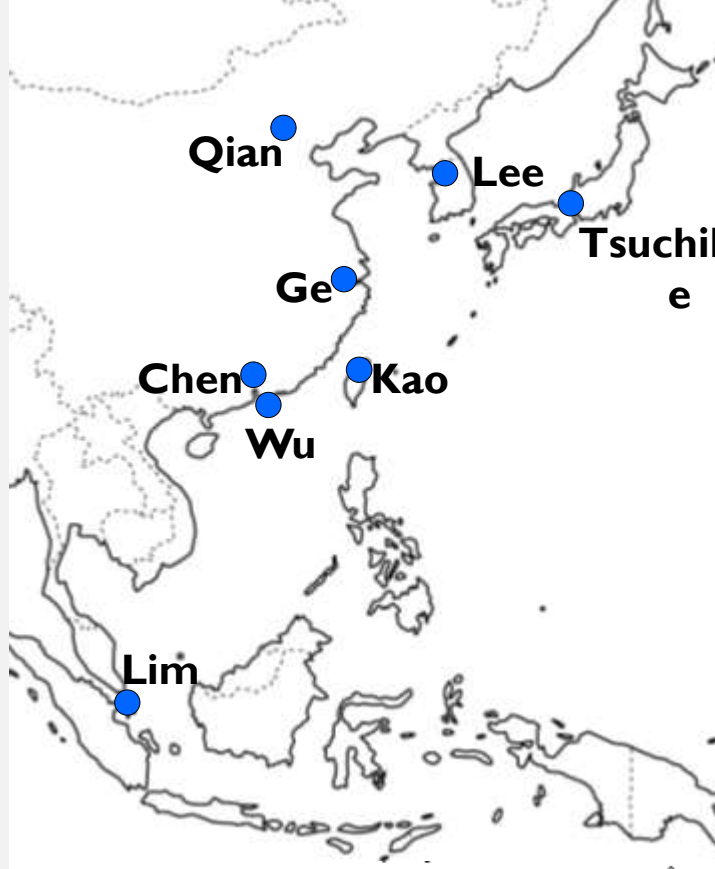
ASIAN-PACIFIC CTO CLUB

KICK-OFF MEETING@CIT2015, BEIJING
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DIRECTORS

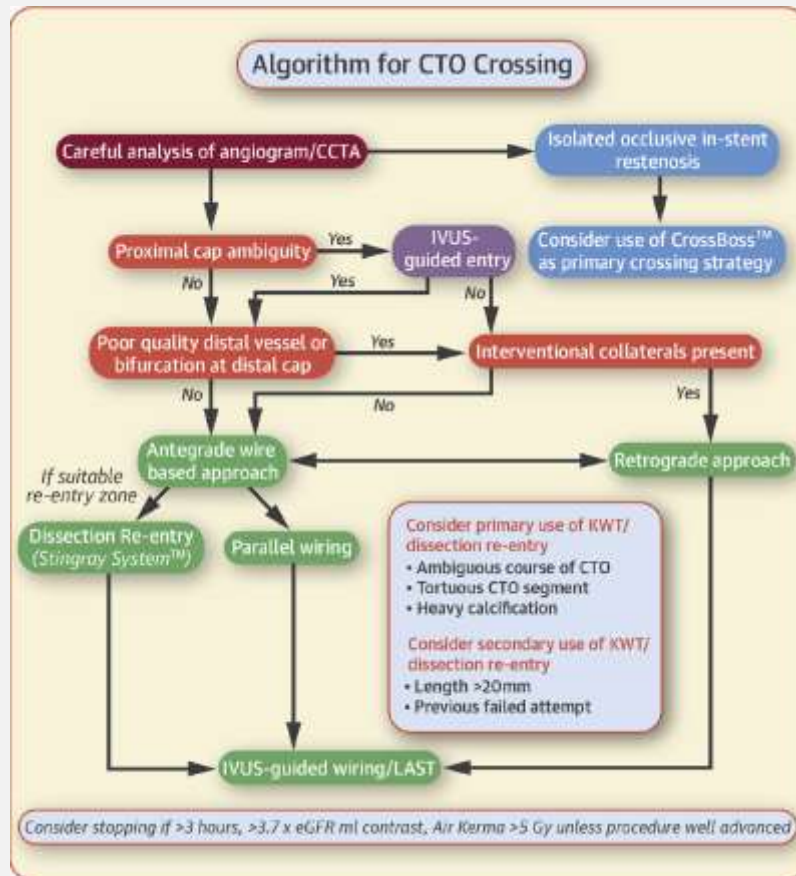
Ji Yan Chen	Guangdong General Hospital	China
Lei Ge	Zhongshan Hospital Fudan University	China
Scott Harding	Wellington Hospital	New Zealand
Paul Hsien-Li Kao	National Taiwan University Hospital	Taiwan
Seung-Whan Lee	Asan Medical Center	Korea
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APCTO CLUB REGISTRY.

- 8 out of the 10 directors submitted their consecutive primary operator cases in a CTO registry from 1.1.2016 to 31.12.2016.
- Only exclusion was proctoring.
- The cases were performed after discussion and agreement to a CTO algorithm.
- 485 patients with 497 CTO performed in 2016 were included.

FIGURE 1. APCTO CLUB ALGORITHM FOR CTO CROSSING.



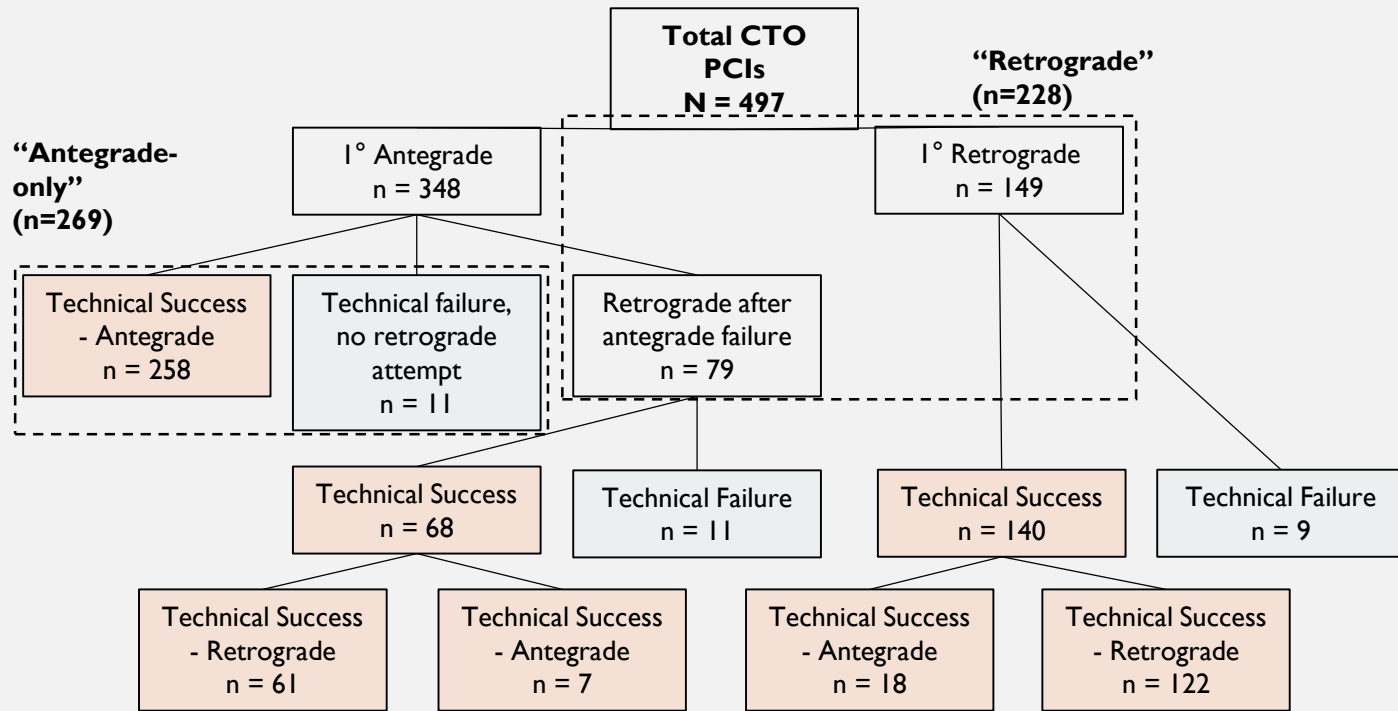
	Antegrade Only (n=259)	Retrograde used (n=226)	Total (n=485)	P value
Age, years, mean±SD*	62.2±11	60.6±11.9	61.4±11.4	0.12
Age≥75 years	30 (11.6%)	28 (12.5%)	58 (12%)	0.77
Male	229 (88.8%)	198 (88%)	427 (88.4%)	0.77
Prior CABG	14 (5.4%)	15 (6.6%)	29 (6%)	0.57
Prior PCI	133 (51.4%)	175 (77.4%)	308 (63.5%)	<0.001
History of MI	91 (35.1%)	71 (31.4%)	162 (33.4%)	0.39
Hypertension	189 (73%)	164 (72.6%)	353 (72.8%)	0.92
Diabetes mellitus	90 (34.7%)	76 (33.6%)	166 (34.2%)	0.80
Insulin-treated	10 (3.9%)	12 (5.3%)	22 (4.5%)	
Hyperlipidemia	149 (57.5%)	134 (59.3%)	283 (58.4%)	0.69
Smoking	121 (46.7%)	126 (55.8%)	247 (50.9%)	0.047
Current smokers	64 (24.7%)	78 (34.5%)	142 (29.3%)	0.02
PAD	13 (5%)	9 (4%)	22 (4.5%)	0.58
Family History	17 (6.6%)	28 (12.4%)	45 (9.3%)	0.03
Stroke	16 (6.2%)	9 (4%)	25 (5.2%)	0.28

	Antegrade Only (n=259)	Retrograde used (n=226)	Total (n=485)	P value
Clinical Indication				
Old myocardial infarction	47 (18.2%)	32 (14.2%)	79 (16.3%)	0.02
Acute myocardial infarction	0 (0%)	2 (0.9%)	2 (0.4%)	
Unstable angina	29 (11.2%)	12 (5.3%)	41 (8.5%)	
Stable angina	155 (60.1%)	162 (71.7%)	317 (65.5%)	
Asymptomatic	27 (10.5%)	18 (8%)	45 (9.3%)	
LVEF[†], %, median (IQR) ‡	59 (49-64)	58 (49-64)	58.1 (49-64)	0.90
Low LVEF[†] (<=40%), %	29 (13.7%)	22 (12%)	51 (12.9%)	0.61
Multivessel disease	153 (59.1%)	158 (69.9%)	311 (64.1%)	0.01

	Antegrade-Only	Retrograde	Total	P
	N=269	N=228	N=497	
J-CTO* scores	2.5±1.2	3.4±1.0	2.9±1.2	<0.001
Easy (0)	10 (3.8%)	0 (0%)	10 (2%)	<0.001
Intermediate (1)	46 (17.3%)	7 (3.1%)	53 (10.8%)	
Difficult (2)	71 (26.7%)	36 (15.9%)	107 (21.7%)	
Very difficult (>=3)	139 (52.3%)	183 (81.0%)	322 (65.4%)	
RCA‡	107 (38.2%)	134 (58%)	241 (47.2%)	<0.001
LAD§	121 (43.2%)	82 (35.5%)	203 (39.7%)	
LCX 	52 (18.6%)	14 (6.1%)	66 (12.9%)	
LMT/ SVG¶	0 (0%)	1 (0.4%)	1 (0.2%)	
In-stent restenosis	34 (12.6%)	13 (5.7%)	47 (9.5%)	0.01
Moderate/ Severe tortuosity	56 (20.9%)	40 (17.5%)	96 (19.4%)	0.35
Reattempt lesion	62 (23.0%)	109 (47.8%)	171 (34.4%)	<0.001
Occlusion length ≥20mm	165 (61.6%)	187 (82.4%)	352 (71.1%)	<0.001
Lesion Calcification	178 (66.7%)	177 (78.0%)	355 (71.9%)	0.01

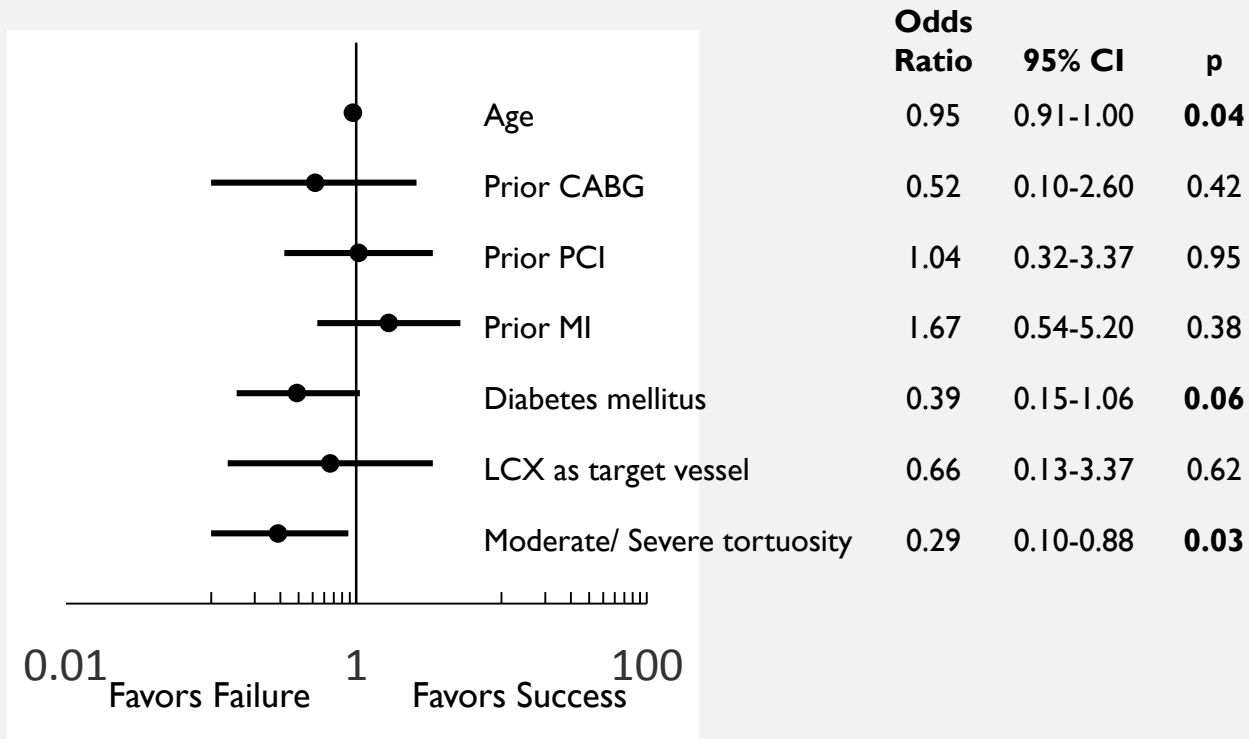
	Antegrade-Only	Retrograde	Total	P
	N=269	N=228	N=497	
Technical success*	258 (95.9%)	208 (91.2%)	466 (93.8%)	0.03
Use of IVUS†	92 (34.2%)	92 (40.4%)	184 (37%)	0.16
Stenting	255 (94.8%)	206 (90.4%)	461 (92.8%)	0.06
DES‡ use	254 (99.6%)	205 (99.5%)	459 (99.6%)	1.00
BMS§ only	1 (0.4%)	1 (0.5%)	2 (0.4%)	
No. of stent implanted at CTO vessel	2.1	2.5	2.3	<0.001
Total stent length	57 (38-76)	76 (61-99)	66 (47.8-87)	<0.001
Procedure time (min¶)	70 (50-110)	120 (100-180)	100 (60-140)	<0.001
Fluoroscopy time (min¶)	31.5 (22-49.2)	67.5 (48-95)	47.3 (28-72)	<0.001
Wire crossing time (min¶)	22.5 (10.3-40)	55 (36.5-83)	37 (18-60)	<0.001

**FIGURE 2. CTO CROSSING STRATEGIES –
FLOWCHART ILLUSTRATING PATIENT
FLOW.**



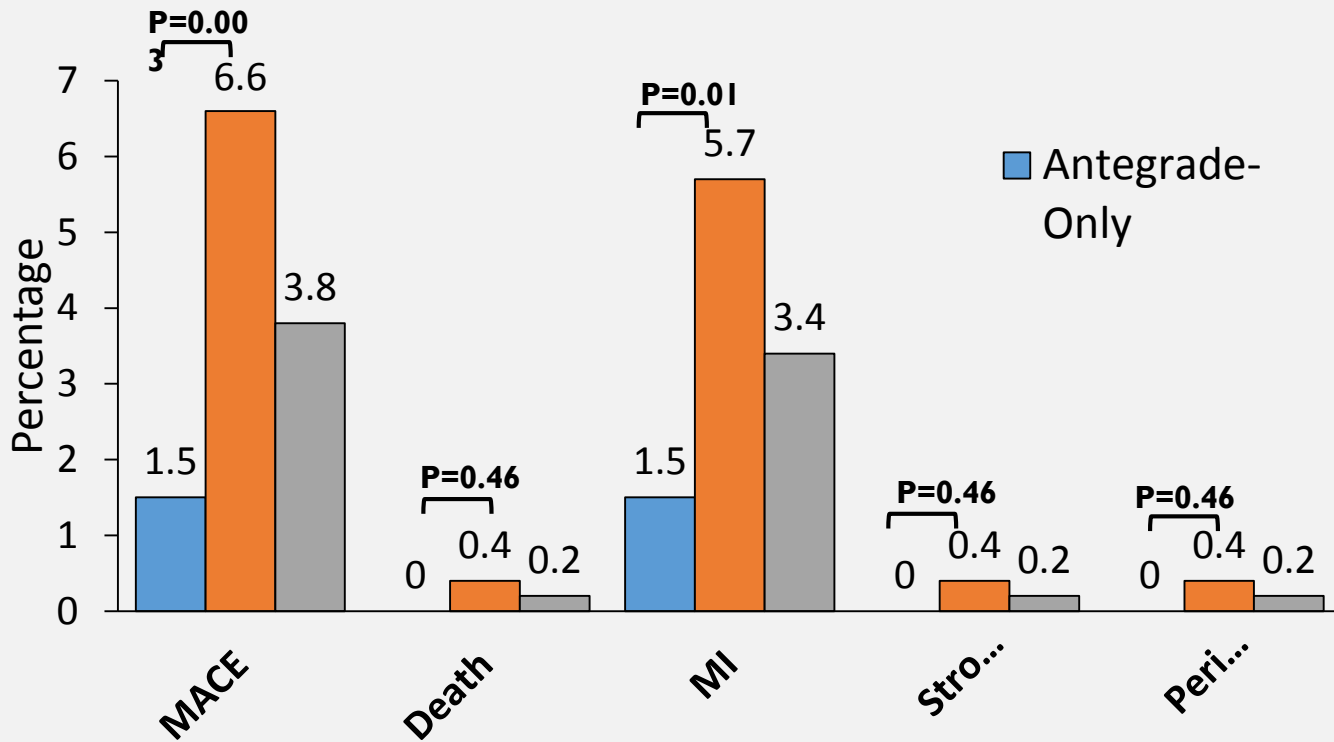
CTO = Chronic total occlusion; PCI = Percutaneous Coronary Intervention; dash line boxes include pure antegrade and pure retrograde cases

FIGURE 3. RETROGRADE SUCCESS – MULTIVARIATE PREDICTORS OF TECHNICAL SUCCESS.



CABG = coronary artery bypass grafting; PCI= percutaneous coronary intervention;
MI= myocardial infarction; LCX= Left Circumflex artery; CI= confidence interval.

FIGURE 4. OUTCOMES - INCIDENCE OF IN-HOSPITAL MACES.



MACE = Major Adverse Cardiovascular Event; MI= myocardial infarction.

HOW DO WE COMPARE WITH
OTHERS?

Author	Country	Duration of recruitment	n	Technical success	Procedural success	JCTO*	% retrograde	Cx or MACE†
Lee 2017 [13]	Taiwan	2012-2013	321	96.9%	94.1%	3.3	53%	0.6%
Retrograde				96.4%	92.8%			0.7%
Antegrade				97.4%	95.4%			0.6%
Michael 2013 [23]	US	2006-2011	1361	85.5%	84.2%		34%	1.8%
Retrograde				80.9%	78.5%			3.4%
Antegrade				87.8%	87.1%			0.9%
Karpaliotis 2016 [10]	US	2012-2015	1301	90%	89%	2.5	41.4%	2.4%
Retrograde				84.8%	81.9%	3.1		4.3%
Antegrade				93.7%	93.3%	2.1		1.1%
Tsuchikane 2013 [22]	Japan	2009-2010	801	84.8%	83.8%		26.6%	1.6%
Retrograde				71.2%	70.3%			
Maeremons 2016 [18]	RECHARGE	2014-2015	1253	86%		2	34%	2.6%
Retrograde	Europe			62%				
Christensen 2017 [24]	Denmark	2010-2015	594	69%		3	17%	4%
Retrograde				65%				
Antegrade				72%				
Suzuki 2017 [25]	Japan	2014-2015	2846	89.9%	88.8%	2	27.8%	1.1%
Retrograde				87.3%	85%	2.4		2.3%
Antegrade				91%	90.3%	1.9		0.7%
Wu et al	Asiapacific	2016-2016	497	93.8%	89.9%	2.9	46%	3.8%
Retrograde				91.2%	84.6%	3.4		6.6%
Antegrade				95.9%	94.4%	2.5		1.5%

Author	Contrast/mls	Fluoro time/mins	Radiation/Gy*	Procedure/mins
Lee 2017 [13]	265.5	42	5.5	105
Retrograde	287.3	50	6.5	122.5
Antegrade	241.3	33	4.3	85
Michael 2013 [23]	294	42	4.7	113
Retrograde	343	61	6.4	150
Antegrade	268	32	3.7	95
Karpaliotis 2016 [10]	260	45.6	3.5	125
Retrograde	300	73.8	4.8	183
Antegrade	245	31.8	2.6	100
Maeremons 2016 [18]	250	35	1.6	90
Suzuki 2017 [26]	230			160
Retrograde	246			202
Antegrade	225			144
Wu 2018	250	47.3	3	100
Retrograde	300	67.5	4	120
Antegrade	210	31.5	2	70

CONCLUSION

- With an algorithm driven CTO PCI a group of experienced operators can achieve 93.8% success in a very difficult cohort of CTO patients.
- This can be achieved with very short procedural times 100 mins, very low radiation doses 3 Gy, and acceptable MACE.
- Algorithm driven CTO PCI should be tested in less experienced operators and data collected for further validation.

THANK YOU

- www.apcto.club

TABLE I. PATIENT CHARACTERISTICS ACCORDING TO REGISTRIES

	APCTO	J-CTO (JACC Cardiovasc Interv. 2010;3:143-51)	ERCOT (EuroIntervention. 2011;7:472-9)	PROGRESS (Circ Cardiovasc Interv. 2015;8:e002171)
	N=453	N=498	N=1914	N=650
Age, years, mean±SD	61.1±11.4	66.9±11.0	64.1±11.6	65±10
Male, %	88.0%	81.5	85	87
Comorbidities				
History of CABG, %	5.3	9.6	14.6	36
History of PCI, %	64.9	47.3	51.2	66
Hypertension, %	72.6	55.4	72.3	90
DM, %	33.3	43.3	28.8	42
Hyperlipidemia, %	56.3	55.4	74.9	95
Smoking, %	52.1	-	43.6	35 (current smoking)
Peripheral artery disease, %	4.6	11.2	9.9	16
CAD Family History, %	9.5	-	31.2	-
Prior stroke, %	4.4	1.9	2.4	9
Clinical Indication				
Asymptomatic, %	8.8	29.5	15.4	
AMI, %	0.4	70.5	13.3	-
OMI, %	16.8			
Unstable angina, %	7.7			
Stable angina, %	66.2		71.1	
Baseline eGFR	62.9±25.7	-	92.7±70.4	-
LVEF %, median (IQR) or mean±SD	59 (50-64)	54.7±13.0	-	55 (43-60)
Low LVEF (<-40%) %	12.7	14.7	7.6	

TABLE 2. LESION CHARACTERISTICS ACCORDING TO REGISTRIES.

	APCTO	J-CTO	ERCOT	PROGRES S
	N=462	N=528	N=1983	N=657
J-CTO scores		(sub-study)	(sub-study)	
Easy	2.2	21.4	For retrograde cases, 3 (2-3)	4.4
Intermediate	10.4	28.0		33.9
Difficult	22.9	28.0		24.8
Very difficult	65.6	22.5		57.5
CTO vessels				
RCA	49.6%	44.3	50.1	61.0
LAD	40.0%	36.0	29.7	21.0
LCX	10.2%	19.1	19.4	18.0
LX/ LMT/ SVG	0.2%	0.6	0.8	-
Reattempt lesion	36.8	10.2	-	17.0
Occlusion length ≥20mm	72.3	-	69.7	-
Lesion Calcification	71.2	54.9	-	-
Mild	37.7			
Moderate	52.9	-	-	59.0
Severe	9.4	-	11.8	
Lesion bending >45 degree	56.1	44.9	32.7	34.0
CTO Entry Shape, blunt	55.4	38.6	50.5	52.0

JCTO SCORE

- Mean JCTO score 2.9 +/- 1.2
- Reattempt case 3.8 +/- 1.0
- First attempt 2.4 +/- 1.0

TABLE 3. PROCEDURAL DETAILS ACCORDING TO REGISTRIES.

	APCTO	J-CTO	ERCOT	PROGRESS
	N=462	N=528	N=1983	N=657
Successful approach				
Antegrade only	51.5	-	-	39.0
Retrograde(+Antegrade)	41.8	-	-	25.0
Retrograde(+Antegrade) unsuccessful→Antegrade	6.7	-	-	29.0
Stenting	93.3	97.3	81.0	93.0
No. of stent implanted at CTO vessel	2.3±0.9	-	2.4±1.2	2.6±1.1
Total stent length	70.1±28.6	48.6±24.6	46.6±16.2	-
Contrast dose (ml)	250 (200-320)	293 (53-1,097)	313.2±184.4	250 (190-350)
Fluoroscopy time (minutes)	48 (28.8-72.3)	45 (1-301)	42.3±47.4	41 (26-66)
Procedure time (minutes)	100 (60-140)	-	105±57.4	111 (77-160)
Technical success rate	93.9 (TIMI 3 flow and < 30% stenosis)	86.6	82.9	93.0

Table 5. Procedural complications and In-hospital outcomes according to registries.

	APCTO	J-CTO	ERCOT	PROGRESS
	N=462	N=528	N=1983	N=657
Procedural complications, %				
Coronary embolism	0.2	-	-	-
Hemorrhagic stroke	0.2	0	0.1	-
Coronary perforation	1.7	-	2.6	-
Cardiac tamponade	-	0.5	-	-
Emergent CABG	0	0	0.2	0
Emergent PCI	0	0.4	-	1.5
In-hospital outcomes, %				
Death	0.2	0.4	0.3	0.3
MI	3.7	2.3	1.3	0.8
Stent thrombosis	0.4	0	0.1	0

APCTO PROCEDURAL AND IN-HOSPITAL OUTCOMES ACCORDING TO J-CTO SCORE.

	Easy	Intermediate	Difficult	Very Difficult	Total	P*	P#
	N=10	N=48	N=101	N=303	N=462		
Procedural success, %	90	95.8	85.1	88.4	88.5	0.18	0.30
Procedure outcomes							
CTO wire cross success, %	100	97.9	93.1	93.7	94.2	0.35	0.54
Technical success, %	100	95.8	94.1	93.4	93.9	0.65	0.78
Procedure time (min)	63 (37.5-124.8)	58 (47-88)	94 (60-132)	120 (70-150)	100 (60-140)	<0.001	<0.001
Fluoroscopy time (min)	27.6 (13.4-48.3)	27.2 (20-38)	44 (25-67)	55 (35-79.6)	48 (28.8-72.3)	<0.001	<0.001
Wire crossing time (min)	12.5 (7.8-29)	22 (13-32)	33 (15-60)	41 (25-67.3)	40 (19.8-60)	<0.001	<0.001
Contrast dose (ml)	220 (147.5-300)	200 (150-275)	250 (190-320)	260 (200-350)	250 (200-320)	0.001	<0.001
Air Kerma Radiation dose (mGy)	1431 (901.2-2307.5)	1791 (1100-2883)	2809 (1775.5-4492.5)	3600 (2100-5671.5)	3269.5 (1841.3-5074.8)	<0.001	<0.001
In-hospital outcomes							
Patient success, %	90.0	100	91.1	94.1	93.9	0.19	0.19
Death, %	0	0	1.0	0	0.2	0.17	0.31
MI, %	10.0	0	5.0	3.6	3.7	0.58	0.33
Stent thrombosis, %	0	0	1.0	0.3	0.4	0.59	0.79
Coronary embolism, %	0	0	0	0.3	0.2	0.77	0.91
Hemorrhagic stroke, %	0	0	1.0	0	0.2	0.17	0.31
Coronary perforation, %	0	0	2.0	2.0	1.7	0.56	0.76
Emergent CABG, %	0	0	0	0	0	NA	NA
Emergent PCI, %	0	0	0	0	0	NA	NA

*P-value of 3-group comparison (J-CTO score 0/1 vs 2 vs ≥3)

#P-value of 4-group comparison

	Easy	Intermediate	Difficult	Very Difficult	Total	P*	P#
	N=10	N=48	N=101	N=303	N=462		
Access to CTO artery, %							
Femoral	40.0	31.3	47.5	61.8	55.0	<0.001	<0.001
Radial	40.0	43.8	20.8	6.6	14.3		
Femoral & Radial	20.0	25.0	31.7	31.6	30.7		
Initial strategy, %							
Antegrade	100	97.9	86.1	56.8	68.4	0.01	<0.001
Retrograde	0	2.1	13.9	43.2	31.6		
Final strategy, %							
Antegrade only	100	85.4	64.4	40.3	51.5	<0.001	<0.001
Retrograde (+Antegrade)	0	12.5	30.7	51.5	41.8		
Retrograde (+Antegrade) unsuccessful → Antegrade	0	2.1	5	8.3	6.7		

*P-value of 3-group comparison (J-CTO score 0/1 vs 2 vs ≥3)

#P-value of 4-group comparison

CONCLUSIONS.

- In a select group of CTO operators, CTO PCI following the APCTO algorithm can produce excellent technical success rates of 93.9%.
- This was achieved despite the high complexity of the CTOs performed.
- Procedural times and contrast dose were similar to those reported in other contemporary registries.
- Periprocedural MI is higher 3.7% (mostly from the high JCTO cases).