Impact of repeat percutaneous coronary interventions for chronic total occlusion following previously failed attempts from the analysis of the Japanese CTO Expert Registry

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I, Makoto Sekiguchi, DO NOT have a financial interest/arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation.

Introduction / Aim

- Chronic total occlusion (CTO) percutaneous coronary intervention (PCI) can be challenging to perform with variable success rates, depending on operator experience and expertise.
- Previous failed attempt of CTO-PCI has been associated with lower procedural success rates and is part of the Japanese Chronic Total Occlusion (J-CTO) score that was developed to predict the likelihood of successful guidewire crossing within 30 minutes.
- The aim of this study is to investigate the impact of repeat CTO-PCI by highly skilled operators following previous failed attempt.

Methods

- The Japanese Board of CTO Interventional Specialists has develop a prospective, nonrandomized registry of patients undergoing CTO-PCI performed selected highly experienced Japanese specialists.
- From 2014 to 2016, the registry included 4177 consecutive CTO-PCI cases. The overall procedure success rate of CTO-PCI was 88.9%. A previous failed attempt had been performed in 844 patients (20.2%).
- We compared the baseline patient and angiographic characteristics, procedural and clinical results between first-attempt PCI and re-attempt PCI. In addition, we analyzed unsuccessful factors of re-attempt CTO-PCI with univariate and multivariate analysis.

Japanese CTO PCI Expert Registry

- The Japanese Board of CTO Interventional Specialists was established in 2013 to accumulate quantitative and reliable data to identify issues such as stagnation in the development of CTO-PCI techniques and to compare with other databases of foreign countries.
- Japanese CTO PCI Expert Registry started a database of CTO-PCI performed by certified expert physicians who have a certain level of CTO-PCI skills from JAN/2014
- Patients are enrolled by certified expert operators.
- Procedure success is adjudicated by a Core-lab

Pts. Enrollment	Jan.2014~
Participants as of JUN.2016	45 of Japanese Expert physicians
Criteria for Participants	▪More than 300 cases of experience of CTO-PCI ▪More than 50 cases of CTO PCI per year ▪Recommendation from two steering committee member
Core lab.	Adjudication of Indication and Procedure Success
Organization	Japanese Board of CTO interventional specialist
Chairman	Etsuo Tsuchikane (initiated by Osamu Katoh and Kazuaki Mitsudo)

Table 1 Baseline Patient Characteristics and Baseline Angiographic Characteristics

	Overall (N = 4177)	1st attempt (N = 3333)	Re-attempt (N = 844)	p Value
Age, yrs	66.8 ± 10.8	67.2 ± 10.9	65.3 ± 10.7	<0.001
BMI, kg/mm	24.7 ± 4.0	24.6 ± 3.7	25.1 ± 4.7	0.004
LVEF	54.9 ± 12.9	54.7 ± 13.0	56.0 ± 12.2	0.009
eGFR	63.6 ± 27.2	63.4 ± 27.4	64.4 ± 26.1	0.339
Male	3583 (85.8)	2844 (85.3)	739 (87.6)	0.098
Hypertension	3256 (78.0)	2586 (77.7)	670 (79.7)	0.292
Dyslipidemia	3238 (77.5)	2532 (76.1)	706 (83.9)	<0.001
Diabetes	1885 (45.1)	1497 (45.0)	388 (46.1)	0.437
Dialysis	265 (6.3)	202 (6.1)	63 (7.5)	0.143
Current smoking	2283 (54.7)	1827 (54.9)	456 (54.2)	0.313
OMI	2088 (50.0)	1630 (49.0)	458 (54.5)	0.006
Prior CABG	310 (7.4)	254 (7.6)	56 (6.7)	0.620
Prior PCI	2768 (66.3)	1924 (57.8)	844 (100.0)	<0.001
Number of diseased vessels				<0.001
Single VD	1972 (47.2)	1480 (44.5)	486 (57.7)	
Double VD	1229 (29.5)	990 (29.8)	237 (28.1)	
Triple VD	821 (19.7)	722 (21.7)	98 (11.6)	
LMT + multiple VD	154 (3.7)	133 (4.0)	21 (2.5)	
Target vessel				<0.001
LAD	1328 (31.8)	1068 (32.1)	260 (30.8)	
LCX	715 (17.2)	620 (18.6)	95 (11.3)	
LMT	17 (0.4)	12 (0.4)	5 (0.6)	
RCA	2116 (50.6)	1632 (49.0)	484 (57.3)	
Syntax score	16.7 ± 8.9	17.2 ± 9.0	15.0 ± 8.1	<0.001
J-CTO score	1.92 ± 1.15	1.68 ± 1.05	2.86 ± 1.03	<0.001
CTO length ≥ 20mm	2401 (57.5)	1886 (56.6)	515 (61.1)	0.060
Lesion calcification	2145 (51.4)	1675 (50.3)	470 (55.6)	0.005
Tortuosity of CTO lesion	959 (23.0)	721 (21.7)	238 (28.2)	<0.001
Morphology of proximal cap				0.016
Blunt	911 (21.8)	724 (21.7)	187 (22.2)	
No stump	768 (18.3)	607 (18.2)	161 (19.1)	
Tapered / tunnel	2457 (58.9)	1978 (59.4)	479 (56.8)	
Unclear	41 (1.0)	24 (0.7)	17 (2.0)	
In-stent occlusion	536 (12.8)	443 (13.3)	93 (11.0)	0.084
Vessel diameter < 3.0mm	2822 (67.6)	2261 (68.3)	561 (67.2)	0.533
Side branch at proximal cap	1514 (36.2)	1226 (36.8)	288 (34.2)	0.161
Proximal tortuosity	2074 (49.7)	1651 (49.6)	423 (50.2)	0.758
Poor distal target	1637 (40.6)	1380 (41.4)	317 (37.6)	0.045
Collateral filling				0.008
Contralateral	2084 (49.9)	1631 (49.0)	453 (53.7)	
Ipsilateral	544 (13.0)	460 (13.8)	84 (10.0)	
Both	1517 (36.3)	1215 (36.5)	302 (35.8)	
None	29 (0.7)	25 (0.8)	4 (0.5)	
Collateral filling grade				0.008
CC0	233 (5.6)	203 (6.1)	30 (3.6)	
CC1	1630 (39.0)	1306 (39.2)	324 (38.4)	
CC2	2312 (55.4)	1822 (54.7)	490 (58.0)	
Unclear	2 (0.1)	2 (0.1)	0 (0)	

Table 3. Multivariate Analysis Investigating Possible Predictor of Failed Re-attempt PCI

	Univariate Analysis			Multivariate Analysis		
Reattempt (N=844)	Success (N=711)	Failure (N=133)	p value	OR	95%CI	P.VALUE
Dialysis	4.0 (5.8)	19 (14.7)	0.001	1.18	0.49-2.85	0.71
High J-CTO score (3-5)	410 (59.4)	98 (76.0)	<0.001	1.66	0.50-5.54	0.41
Occlusion length (>20mm)	412 (59.7)	81 (69.0)	0.049	1.19	0.48-2.99	0.7
Diabetes	309 (44.9)	70 (54.3)	0.028	0.15	0.01-2.73	0.2
Tortuosity of CTO lesion	175 (25.4)	57 (44.2)	<0.001	1.78	0.73-4.33	0.2
Severe calcification	51 (7.4)	26 (20.2)	<0.001	7.83	2.13-28.80	0.002
Moderate calcification	96 (13.9)	21 816.3)	<0.001	2.36	0.65-8.49	0.19

Table 2 Procedural and Clinical Results

	Overall (N = 4177)	1st attempt (N = 3333)	Re-attempt (N = 844)	p Value
GW success	3847 (92.1)	3094 (92.8)	753 (89.2)	0.002
Technical success	3757 (88.9)	3028 (90.8)	729 (86.4)	<0.001
Procedural success	3614 (86.5)	2922 (89.7)	692 (84.3)	<0.001
Procedure time, min	158.1 ± 88.9	150.5 ± 86.6	188.5 ± 91.5	<0.001
Contrast volume, ml	222.5 ± 102.6	217.6 ± 100.0	242.2 ± 110.1	<0.001
In-hospital death	12 (0.3)	12 (0.4)	0 (0)	0.141
Myocardial infarction	47 (1.1)	30 (0.9)	17 (2.1)	0.001
Acute stent thrombosis	7 (0.2)	5 (0.2)	2 (0.2)	0.634
Stroke	12 (0.3)	7 (0.2)	5 (0.6)	0.073
Emergent CABG	2 (0.1)	2 (0.1)	0 (0)	1
Emergent PCI	7 (0.2)	5 (0.2)	2 (0.2)	0.634
Coronary perforation	190 (4.5)	135 (4.1)	57 (7.0)	0.001
Cardiac tamponade	17 (0.4)	13 (0.4)	4 (0.5)	0.762
Complication of puncture site	63 (1.5)	51 (1.6)	12 (1.5)	1
CIN	246 (5.9)	193 (5.8)	53 (6.3)	0.568

Results

- As compared with the first attempt PCIs, the re-attempt PCIs had higher Japanese CTO score (1.68±1.1 vs 2.86±1.0, p<0.001), and were more likely to have renal failure on dialysis (5.1% vs 7.0%, p=0.042) and to undergo recanalization attempts using the bidirectional approach (40.1% vs 67.6%, p<0.001).
- Procedure time (150±87 vs 188±92 min, p<0.001) and contrast volume (218±100 vs 242±110 ml, p<0.001) were bigger in the re-attempt PCIs.
- The rate of myocardial infarction (0.9% vs 2.1%, p=0.01) and coronary perforation (4.1% vs 7.0%, p=0.001) were higher in the re-attempt PCIs. However, there was no significant difference of the rate of cardiac tamponade, emergent PCI and CABG.
- The technical (90.8% vs 86.4%, p<0.001) and procedural (89.7% vs 84.2%, p<0.001) success rate were lower in the re-attempt PCIs. However, the technical success rate in the prior failure group of this study was higher, compared with the retry cases of Multicenter CTO Registry in Japan which was reported nine years ago and developed J-CTO score system (86.4% vs 68.5%).
- From the analysis of repeat CTO-PCI procedure with a prior failed attempt, compared with the success group (711 patients), the failure group (133 patients) were more likely to have diabetes (44.9% vs 54.3%, p=0.028) and renal failure on dialysis (5.8% vs 14.7%, p=0.001) and higher J-CTO score (2.81+1.0 vs 3.19+1.0, p<0.001).
- The success rate of retrogradely guidewire crossing through the collateral channel was higher in the success group of repeat CTO-PCI (84.2% vs 55.6%, p<0.001). Severe lesion calcification was a strong predictor of the failure of repeat CTO-PCI (OR=7.83, 95% CI=2.13-28.80, p=0.002).

Conclusions

- The repeat CTO-PCIs in our registry are associated with patient characteristic and angiographic complexity, longer procedure time and high contrast volume.
- The success rate of repeat CTO-PCI by highly skilled operators following previously failed attempt may be acceptable.
- The CTO lesion with severe calcification remains a difficult problem.