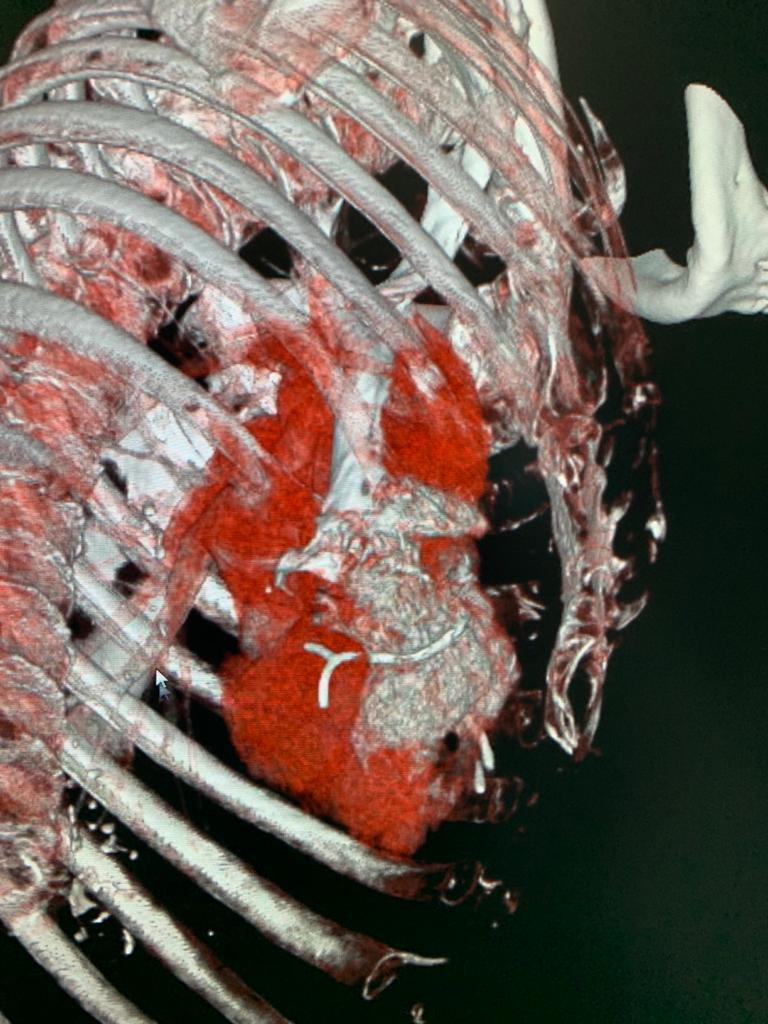
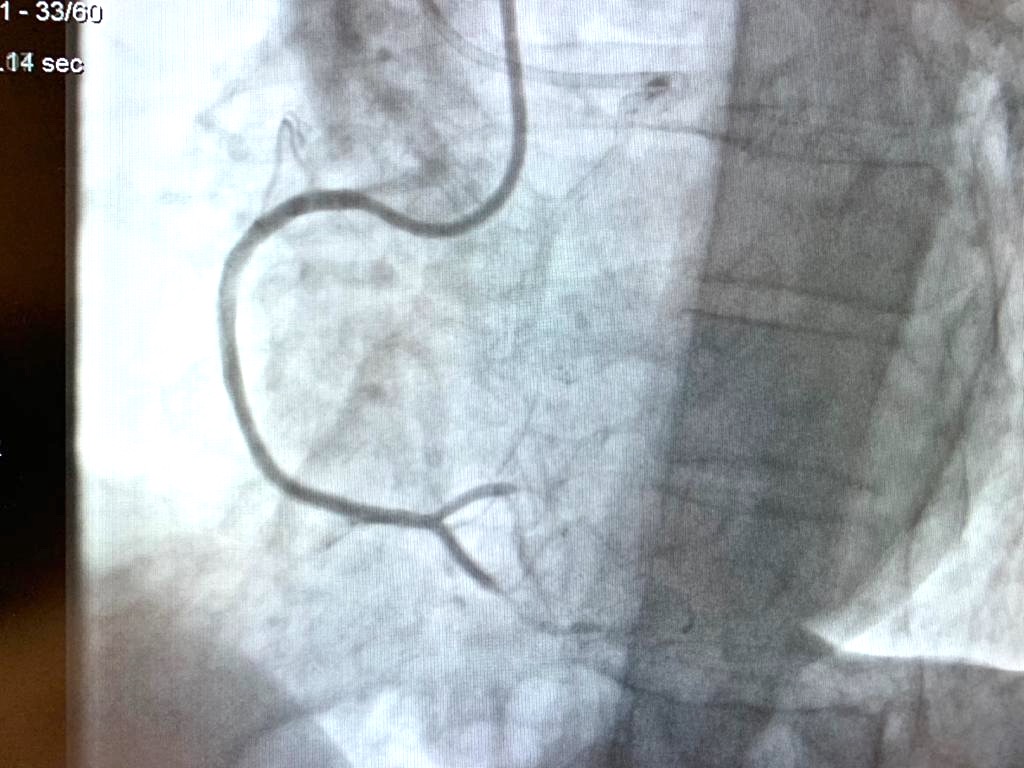
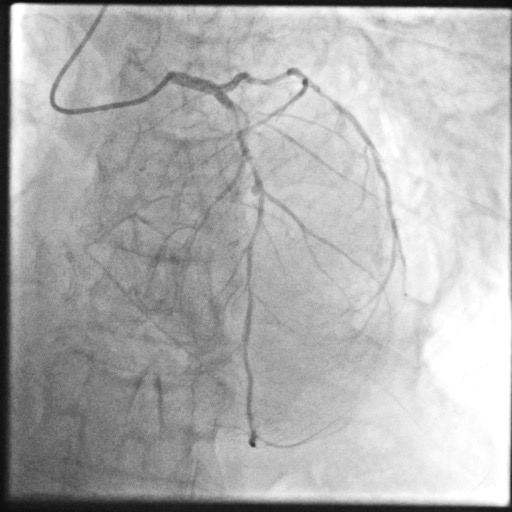
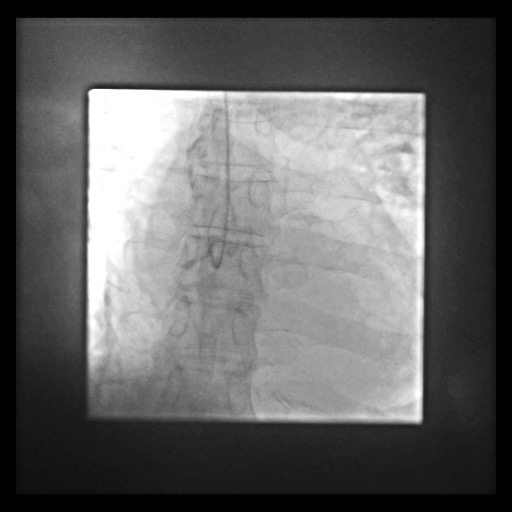
Additional cases of subintimal shift (SIS)

*Case 4*

A 66 years-old male patient with insulin-requiring diabetes mellitus type II was recurrently admitted for heart failure decompensation in the preceding 6 months. Transthoracic echocardiogram showed an ejection fraction of 30%, with no clear wall motion abnormalities (WMA). Coronary angiography showed severe 3-vessels disease, with CTO of the proximal RCA. Rentrop 3, CC1 septal collaterals were provided by the LAD, showing the extension of the occlusion up to the crux cordis (Medina 100). The patient refused surgical revascularisation, so the lesions in LAD and LCx were percutaneously revascularised in a first step, while the PCI of the RCA-CTO was scheduled 1 week later. Ultimate and Gaia 3rd wires (Asahi Intecc, Aichi, JP) progressed antegradely up to the mid RCA, where they diverted extraplaque. Then the operators switched to a retrograde approach through a septal collateral with a Caravel microcatheter (Asahi Intecc, Aichi, JP). A Gaia 2nd wire (Asahi Intecc, Aichi, JP) progressed retrogradely up to the proximal cap and a Reverse CART enabled the unproblematic externalisation of the wire. Over the RG3 wire (Asahi Intecc, Aichi, JP), Xience everolimus-eluting stents 3x28mm, 3x33m and 3.5x23mm (Abbott Vascular, Santa Clara, CA, USA) were overlapped from distal to proximal, adjusted to the bifurcation at the crux cordis and covering the whole CTO length. However, the first antegrade injection after stenting unravelled the complete occlusion of the PL artery, so far not involved in the intervention, and a new-onset severe stenosis of the PD artery, suggesting SIS as mechanism. Rewiring of the PL was relatively unproblematic with a SUOH 03 wire (Asahi Intecc, Aichi, JP), but several attempts of ballooning failed to restore antegrade flow. After checking the luminal position of the wire by means of injection through the microcatheter, a Xience 2.25x15mm (Abbott Vascular, Santa Clara, CA, USA) was implanted in the PL as T-stenting, restoring TIMI-III flow. The extension of subintimal space toward the PD was solved by overlapping an additional stent Xience in the distal RCA and PD, with excellent angiographic result. At one month follow up, the patient remained asymptomatic and the echocardiogram showed an ejection fraction of 55%, with no WMA.

**Supplementary figure 1: Angiographic summary of case 4.**

Blunt CTO at the proximal RCA (A) with Rentrop 3, CC1 septal collaterals from the LAD, showing the extension of the occlusion up to the crux cordis (Medina 1s00, panel B). After an initial antegrade approach, a retrograde approach via septal collaterals was chosen and a rCART succeeded to externalise the wire. The attempt to adjust the stent to the bifurcation at the crux cordis resulted in the occlusion of the PL artery, that was initially non-involved in the lesion, thus meeting the criteria of SIS, and requiring the implantation of an additional T stent (C,D), with excellent result.



A

B

C

D

LAD: Left anterior descending coronary artery

PL: Posterolateral coronary artery

RCA: Right coronary artery

rCART: Reverse controlled antegrade-retrograde tracking.

SIS: Subintimal Shift

*Case 5*

An 80 years-old male patient was admitted with worsening typical angina. Echocardiography revealed normal left ventricular systolic function without regional WMA. Coronary angiography showed CTO of the mid RCA immediately distal to the take-off of a second right ventricular branch (RV2) (Supplementary figure 2A, arrow). Rentrop 2, CC1 collaterals were provided to PD and PL through septal branches from the LAD. The procedure was initially attempted by antegrade approach, using guiding-catheter extension and parallel-wire technique with GaleoPro (Biotronik, Bülach, CH), Gaia 2nd and Gaia 3rd (Asahi Intecc, Aichi, JP) wires, but this strategy remained unsuccessful (Supplementary figure 2B). The operators switched then to a retrograde approach via septal channels, using a Sion wire with a Corsair microcatheter (Asahi Intecc, Aichi, JP) (Supplementary figure 2C) and a Gaia 3rd wire finally crossed the CTO after different manoeuvres, gained the true lumen, entered the guiding catheter extension, thus being externalised and exchanged by an RG3 wire (Asahi Intecc, Aichi, JP). The CTO segment was then ballooned with no flow-limitation to the RV2 (Supplementary figure 2D, arrow), but observing a linear filling defect at the RCA (warning sign of SIS). After implantation of a Promus Premier Select 2,75x38mm stent (Boston Sci, Marlborough, MA) at the distal segment of the bifurcation RCA-RV2, the RV2 was occluded (Supplementary figure 2E, arrow), thus meeting the angiographic criteria for SIS. As the patient remained asymptomatic and hemodynamically stable, no attempt to rescue the RV2 was undertaken. The mid RCA was stented with overlapping Promus Elite 3,0x38mm and Promus Premier Select 3,0x20mm with good angiographic result in the main vessel, but loss of the RV2 at the end of the procedure (Supplementary figure 2F, arrow). Cardiac troponin I peaked at 4.110,30 pg/ml and the patient remained stable and asymptomatic.

**Supplementary figure 2: Angiographic summary of case 5.**

CTO of the mid-RCA, immediately distal to the take-off of a second right ventricular branch (RV2) (A, arrow). Initial PCI attempt by antegrade approach, showing the wire progression to RV2, due to cap ambiguity at the bifurcation (B). Retrograde passage via septal collaterals shows the retrograde guide wire at the distal cap of the CTO (C). After externalisation of the retrograde wire and antegrade ballooning, a linear filling defect is observed at the RCA (warning sign of SIS) (D), but no flow limitation to RV2 (D, arrow). After stent implantation, adjusted to the distal segment of the bifurcation, RV2 was completely occluded, with distal TIMI 0 flow (E) due to SIS. Since the patient was totally asymptomatic, it was decided not to rescue the RV2. The angiographic result was excellent in the RCA and other side branches (F), but troponin I peaked at 4110,30 pg/ml.



*Case 6*

A 58 years-old male patient was admitted because of progressive dyspnoea and angina pectoris. Echocardiography showed a severely reduced left ventricular ejection fraction (~20 %) without WMA. Coronary angiography revealed a CTO of the mid-RCA at the bifurcation with a large RV2 (Supplementary figure 3A, arrow), with Rentrop 3, CC2 epicardial collaterals from a marginal branch of the LCX, as single finding.

Due to the ambiguity of the cap at the bifurcation RCA-RV2, a retrograde approach was chosen. A Sion wire and a Corsair microcatheter (Asahi Intecc, Aichi, JP) were advanced to the distal RCA. The CTO was retrogradely crossed with a knuckled Fielder XT-A wire (Asahi Intecc, Aichi, JP) (Supplementary figure 3B). After advancing the Corsair microcatheter, a Gaia 1st wire entered the true lumen at the mid RCA and could be externalised and exchanged for a RG3 wire (Asahi Intecc, Aichi, JP). The CTO segment was then dilated with a 3,0mm balloon. After ballooning, a dissection was clearly detectable at the RV2 (Supplementary figure 3C, arrow), thus suggesting SIS triggered by extraplaque balloon inflation at the distal part of the bifurcation. An ulterior antegrade injection confirmed the severe stenosis at the RV2 (Supplementary figure 3D, arrow). RV2 was then antegradely wired for protection before stenting (Supplementary figure 3E), but after implantation of overlapping Promus Premier Select 2,5x16mm, Resolute 3,50x38mm, Promus Premier Select 3,5x20mm in the RCA, RV2 remained open albeit with a significant stenosis (Supplementary figure 3F). Since distal flow was TIMI III, and the patient remained asymptomatic, no further intervention was undertaken.

**Supplementary figure 3: Angiographic summary of case 6.**

CTO of the mid-RCA, at the origin of a second RV branch, with ambiguous cap (A, arrow). Retrograde wire passage through septal collaterals and extraplaque tracking with a knuckled wire up to the proximal cap of the CTO (B). After externalization of the wire the occluded segment was ballooned and a large dissection flap is angiographically detected at the ostium of the RV branch (C, arrow), thus suggesting SIS as mechanism. An antegrade injection confirms the severe stenosis of the RV ostium (D, arrow). RV is rewired for protection before stenting (E) but at the end of the intervention it remained open, with TIMI III flow, notwithstanding the stenosis (F, arrow), so no additional intervention was performed.



*Case 7*

A 49 years-old male patient, with history of inferior STEMI 7 years before, treated with primary PCI and stenting of the proximal RCA, was referred for coronary angiography because of progressive angina pectoris and dyspnoea NYHA II within the last months. Echocardiography showed a mildly reduced left ventricular function with mild inferior hypokinesia. Coronary angiography revealed a patent stent in the proximal RCA and a CTO in the mid-RCA, immediately distal to the take-off of RV2 (Supplementary figure 4A, arrow), receiving Rentrop3 and CC1 septal collaterals from the LAD. A Sion wire with a Corsair microcatheter (Asahi Intecc, Aichi, JP) were retrogradely advanced to the distal RCA (Supplementary figure 4B), where a Gaia 3rd (Asahi Intecc, Aichi, JP) wire finally succeeded to cross the occlusion, entering the true lumen and the guiding-catheter extension to be ultimately externalised and exchanged by a RG3 wire (Asahi Intecc, Aichi, JP). The occluded segment was then predilated with a 3,0mm balloon. The RV2 branch was preserved after ballooning (Supplementary figure 4C, arrow). However, after implantation of overlapping Promus Premier Select 2,5x12mm, Promus Premier Select 2,5x20mm, Promus Premier Select 3,0x24 mm (Boston Sci, Marlborough, MA) and Xience ProA 3,5x12mm stents the RV2 was occluded, meeting angiographic criteria of SIS (Supplementary figure D-E, arrow). The patient was asymptomatic and hemodynamically stable, therefore no attempt to rescue the RV2 branch was undertaken. cTnI peaked at 625,30 pg/ml.

**Supplementary figure 4: Angiographic summary of case 7.**

CTO of the mid-RCA at the origin of a second RV branch (RV2) (A). After retrograde wire passage through septal collaterals, the retrograde wire tracked the occlusion and reached the proximal cap of the CTO (B). A Gaia 3rd wire entered finally the true lumen and was externalised. After antegrade ballooning of the occluded segment, the RV2 was preserved (C), but stent implantation resulted in complete occlusion of the RV2, meeting angiographic criteria of SIS (D). The patient remained asymptomatic and stable, so it was decided not to rescue the RV2 (E), but cTnI peaked at 625,30 pg/ml.

