



# A Patient with Heart Failure & Triple CTO Managed by PCI

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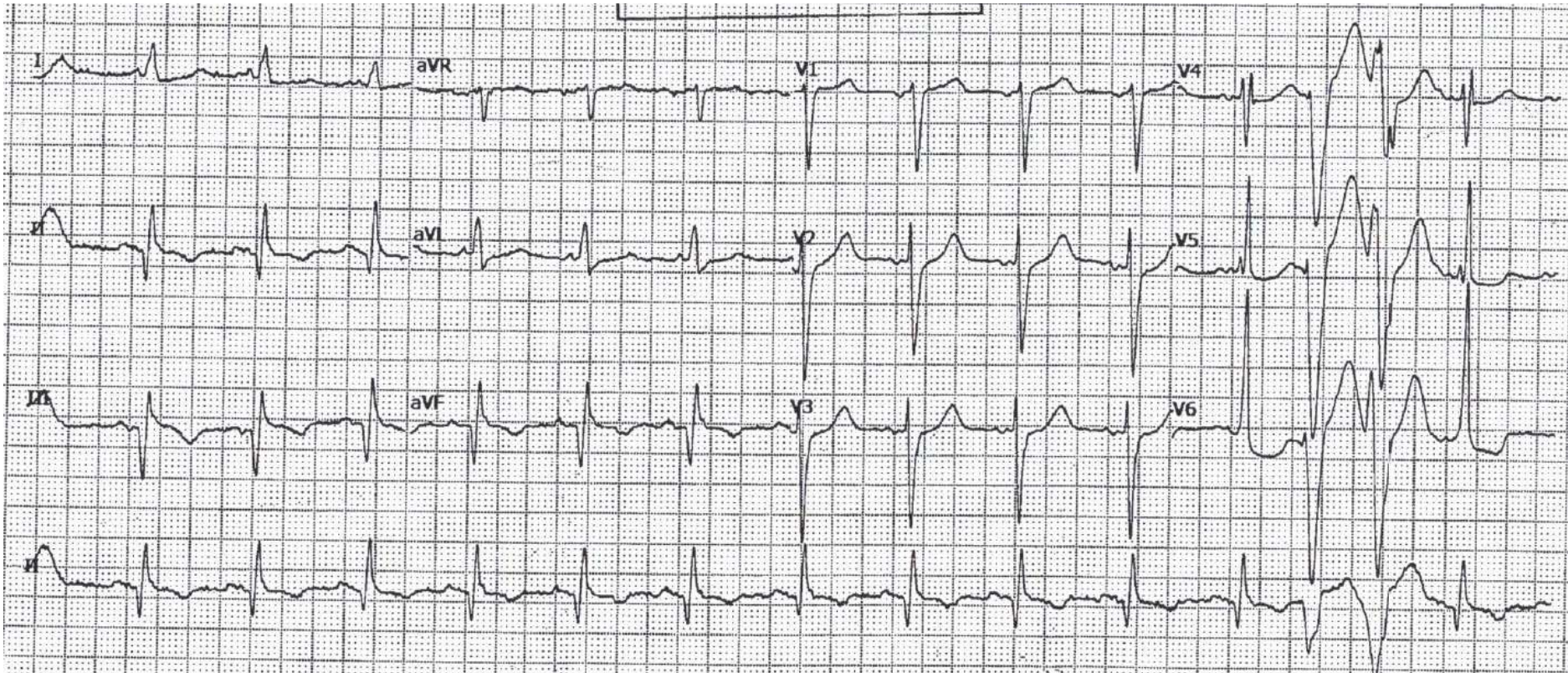


# Case History - 1

- Male / 74 year-old
- Early July 2017: CHF, with SOB and ankle swelling
- Hx of NST-ACS in 2014, no further coronary work up done. Angina symptoms for months
- NIDDM x 10+ yrs, on OHA and Insulin
- Hypertension x 10+ yrs
- Hyperlipidaemia on statin
- COPD with fibrotic changes in CXR
- CKD, Creatinine 150 $\mu$ mol/L range, no proteinuria
- Gout
- Chronic smoker x 40 pack-yrs, quit 10 yrs ago
- Previous SOB, was thought related to COPD



# ECG



# CXR





## Case History - 2

- CXR: cardiomegaly, pulmonary congestion
- ECG: SR with frequent PVCs
- Echo: Dilated LV, enlarged LA. Global hypokinesia of LV, with focal aneurysm at basal inferior wall. Ejection fraction 36%, Restrictive filling pattern of LVDD, moderate MR, mild TR, elevated PASP
- Blood tests: impaired RFT. Creatinine: 170+ $\mu\text{mol/L}$ ; NTproBNP: 2500+
- Diagnosis: CHF, Ischemic cardiomyopathy. DM





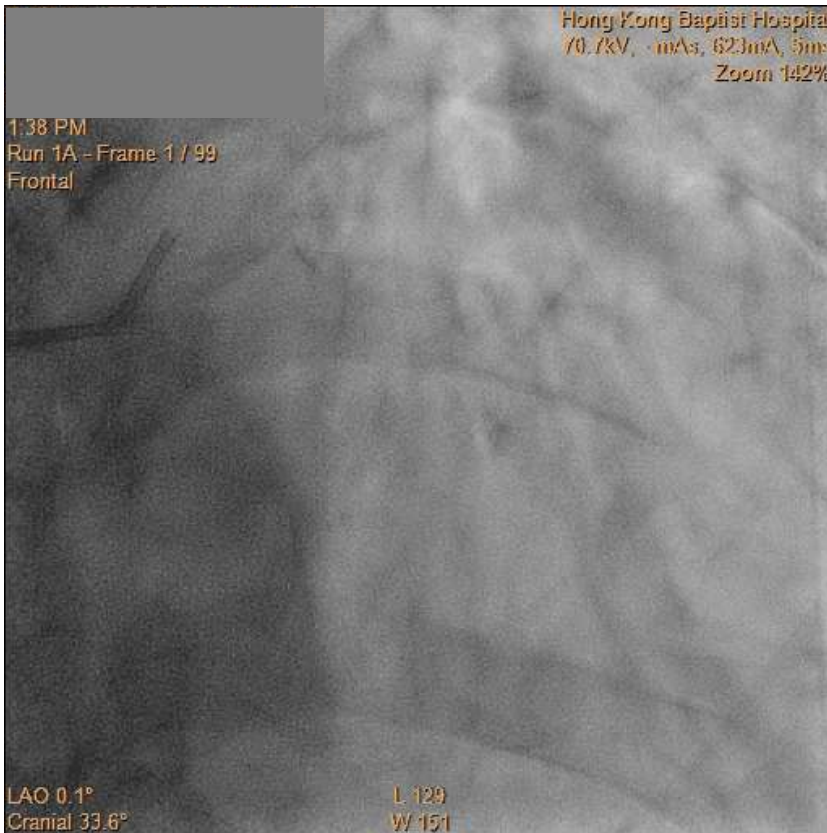
# Case Presentation : Medications

- IV Lasix 40-60mg/day, Slow K
- Cartia 100mg daily, Plavix 75mg daily
- Entresto 50mg BD,
- Pantoloc 20mg daily, Lipitor 10mg daily
- Lantus Insulin, Linagliptin
- Febuxostat 40mg daily
- Others: Harnal 0.4mg N, Vannair, Spiriva, N-Acetylcysteine
- Dopamine infusion (renal dosage)
- Concor 1.25mg OM when CHF symptoms controlled



# Coronary Angiography : ostial LAD CTO

**AP Cranial: ostial LAD CTO, with tiny stump**



**LAO Caudal: LAD CTO, ramus & LCX: mild to mod disease**

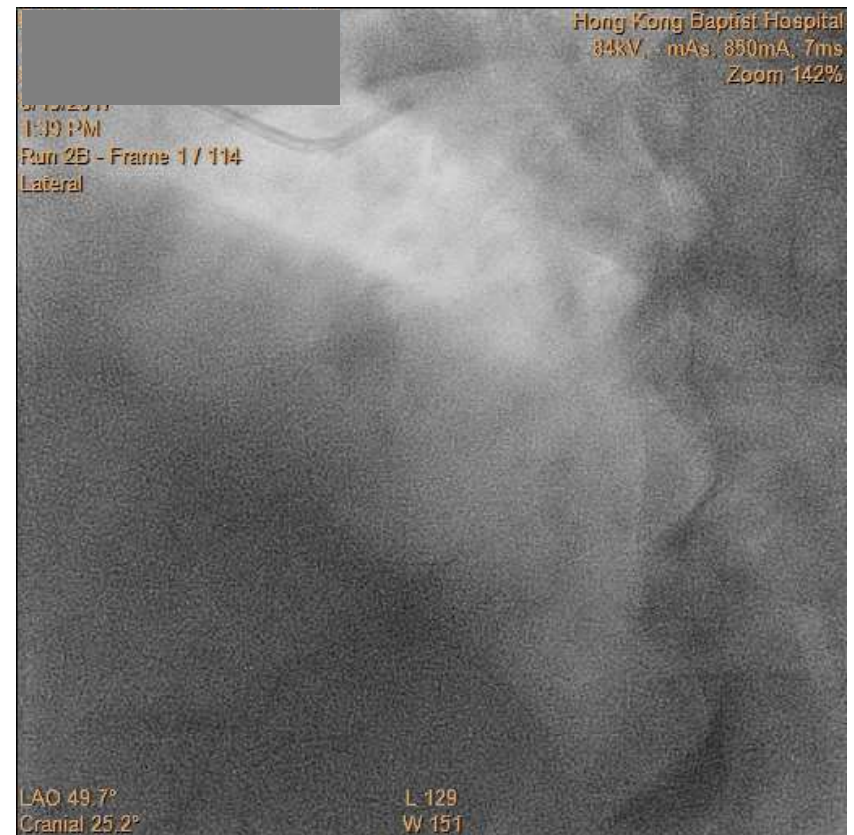


# Coronary Angiography : ostial LAD CTO & ?mLAD CTO

**RAO Caudal: some collateral to LAD**



**LAO cranial: collaterals to mid LAD. ?Double CTO**





# Coronary Angiography : proximal RCA CTO

**RAO: proximal RCA CTO,  
collaterals to LAD**



**LAO: proximal RCA CTO**





# Coronary Angiogram:

- pRCA CTO, some R to R collaterals. L to R collaterals not well formed
- LAO CTO (?double CTO), R to L collaterals not well formed
- LCX CTO in 2 small OM branches, with relatively normal OM3. Some small collaterals to RCA and LAD





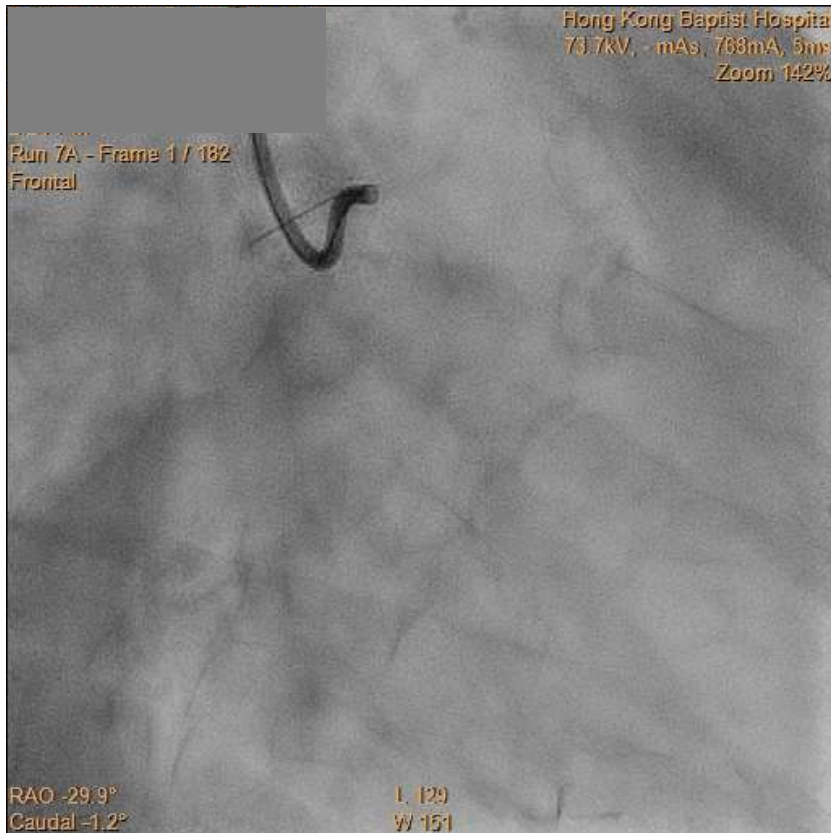
# Case Progress

- Heart failure improved with medications
- Patient refused CABG, and CT surgeon also reluctant for surgery in view CHF, COPD, low EF and CKD
- Consulted renal physician for dialysis support post-PCI
- Patient and family opted for PCI, and proceeded on 15-8-2017 to RCA CTO

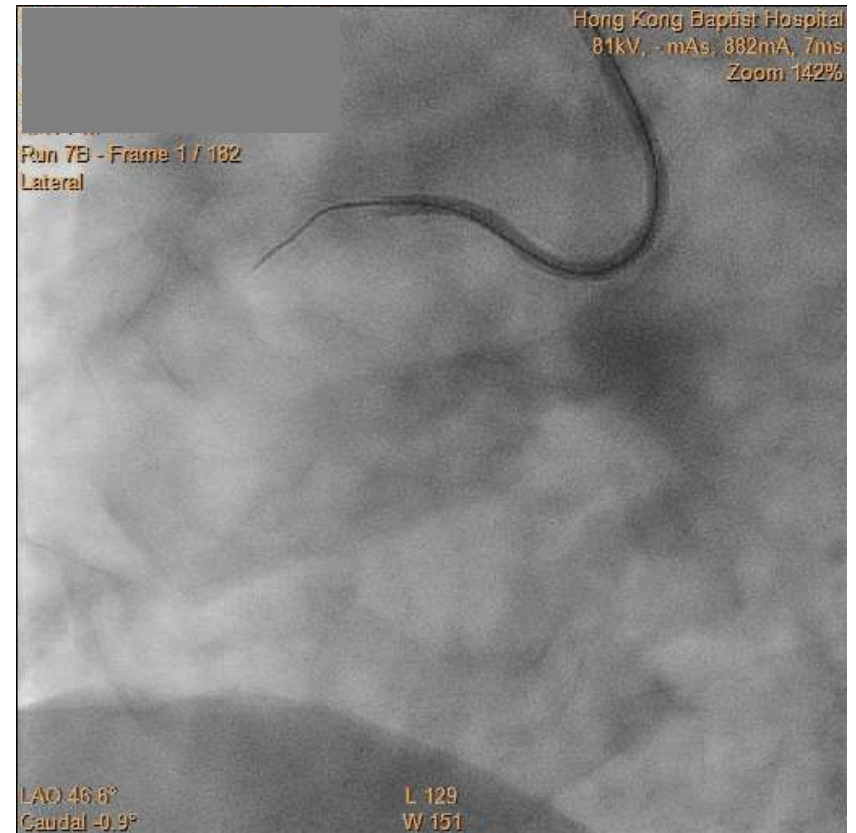


# PCI for RCA CTO : Finecross with XTa

**RAO: Finecross with XTa**

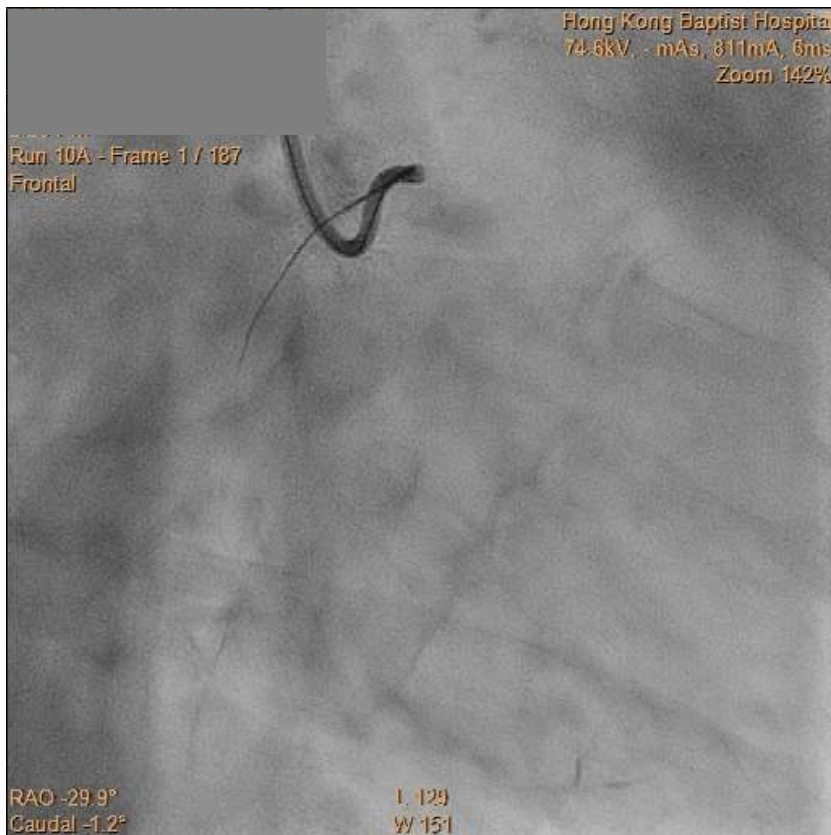


**LAO: unable to penetrate the CTO**

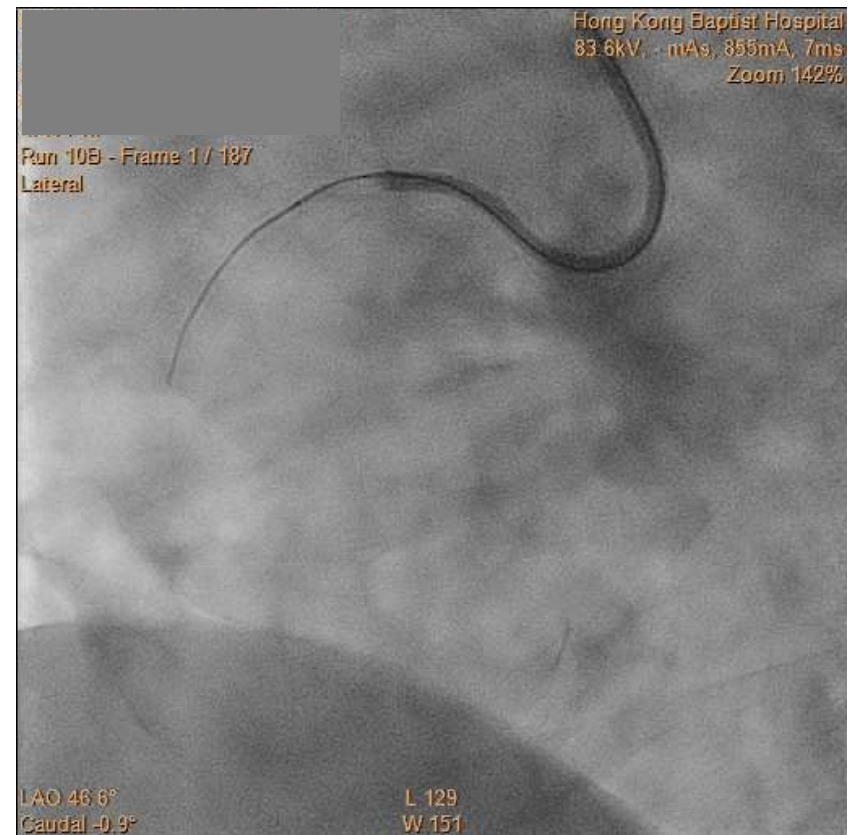


# PCI for RCA CTO : Finecross with Gaia 1st

**RAO: sub-intimal tract**

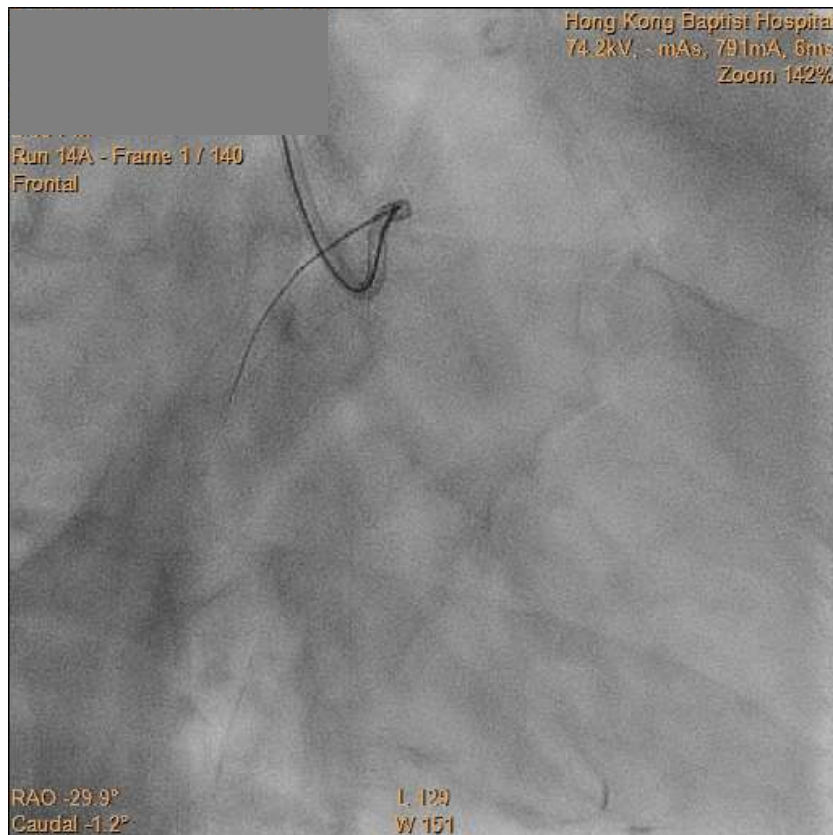


**LAO:**

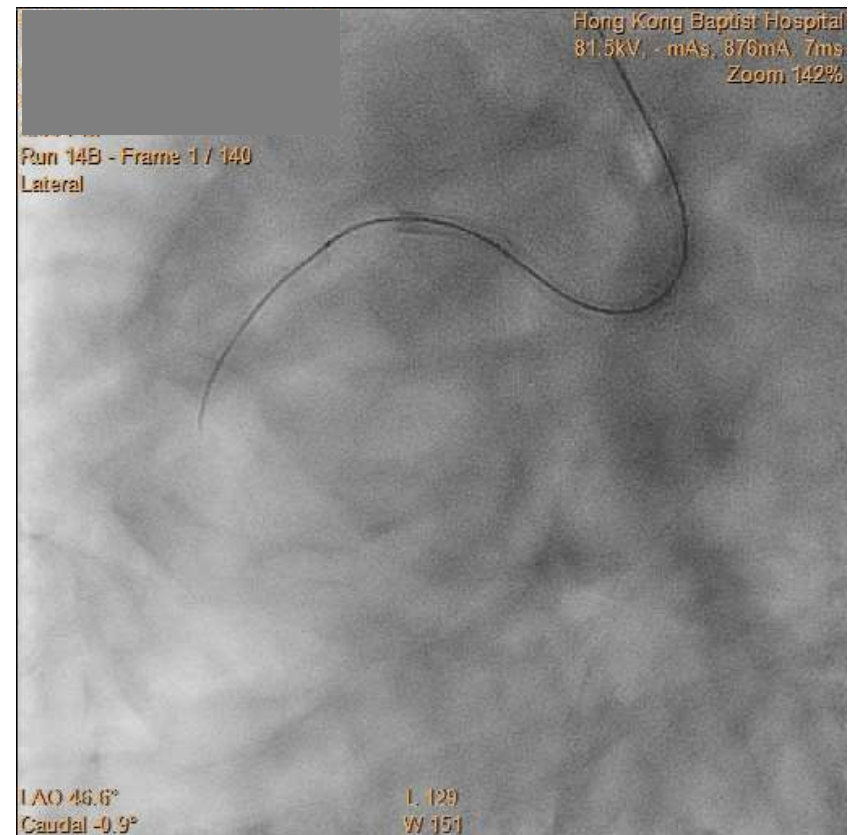


# PCI for RCA CTO : Finecross with Gaia 1st

**RAO: still sub-intimal tract**

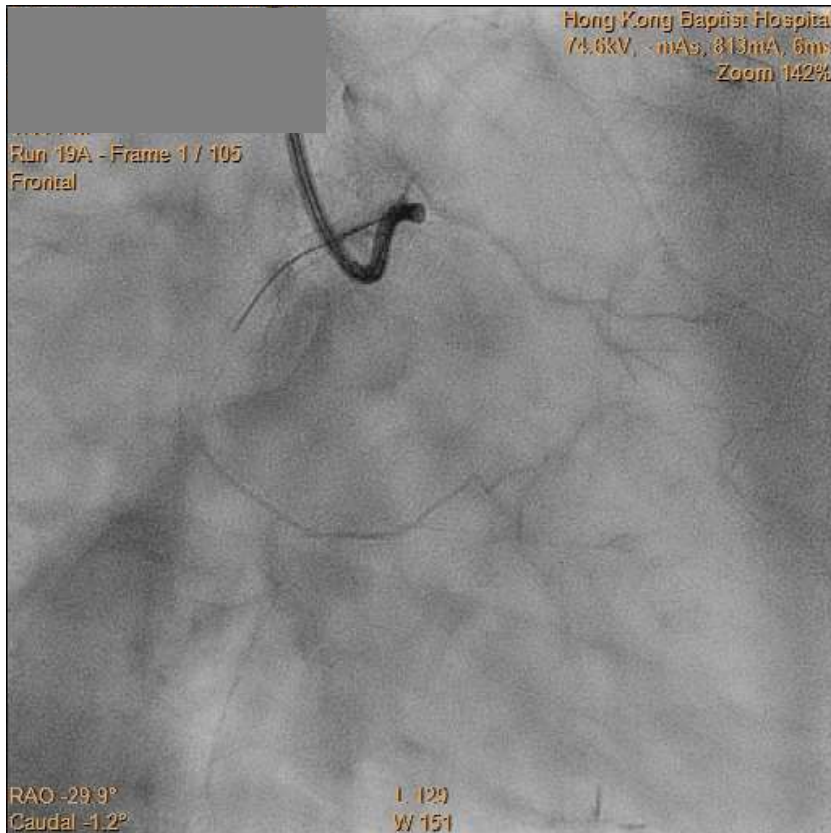


**LAO:**

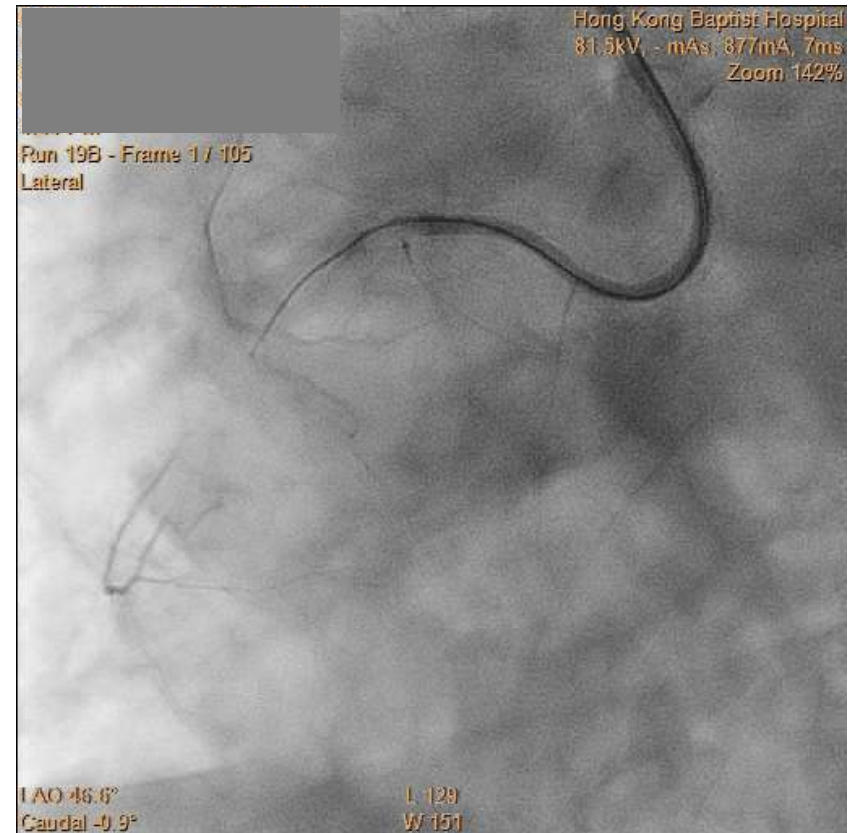


# PCI for RCA CTO : Finecross with Gaia 2<sup>nd</sup>

**RAO: Gaia 2<sup>nd</sup> went a luminal course**

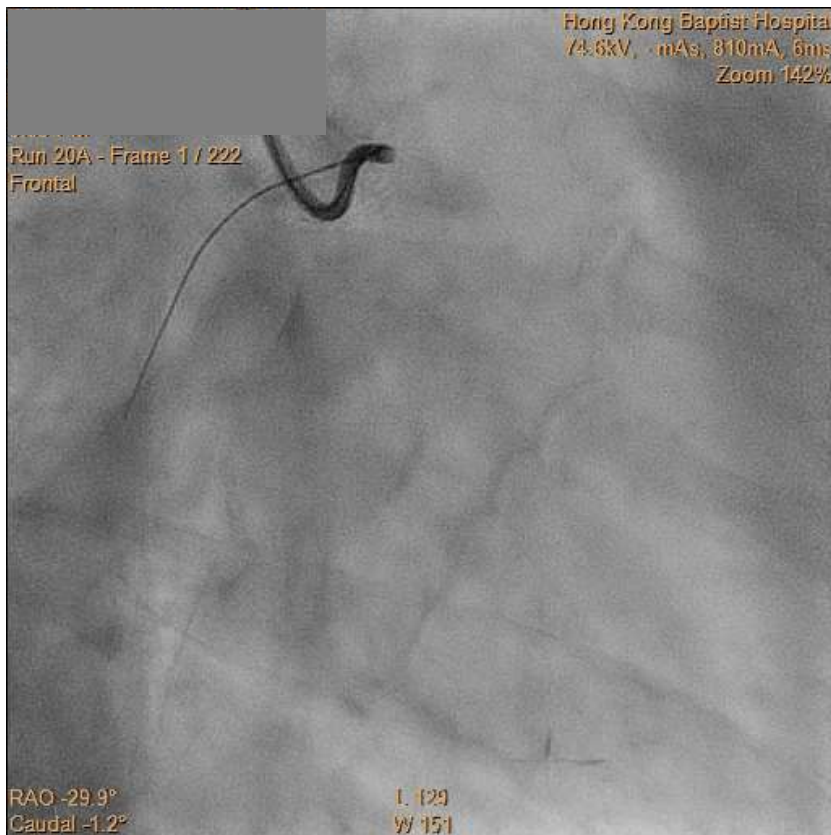


**LAO: Confirmed correct direction of Gaia 2<sup>nd</sup>**

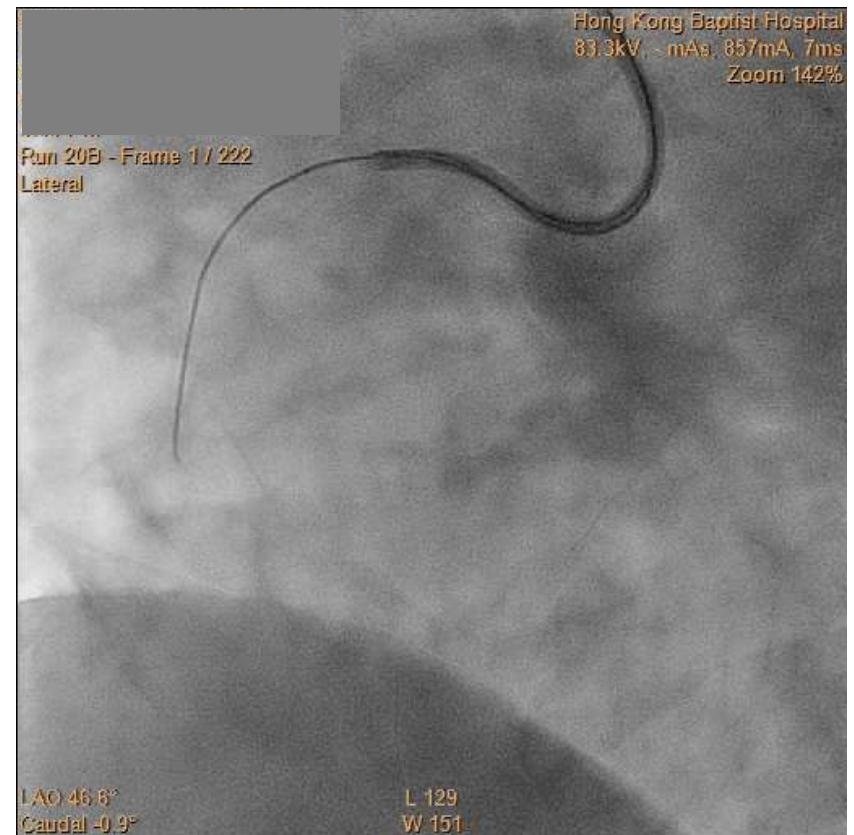


# PCI for RCA CTO : Finecross with Gaia 2<sup>nd</sup>

**RAO: Gaia 2<sup>nd</sup> crossed  
CTO**



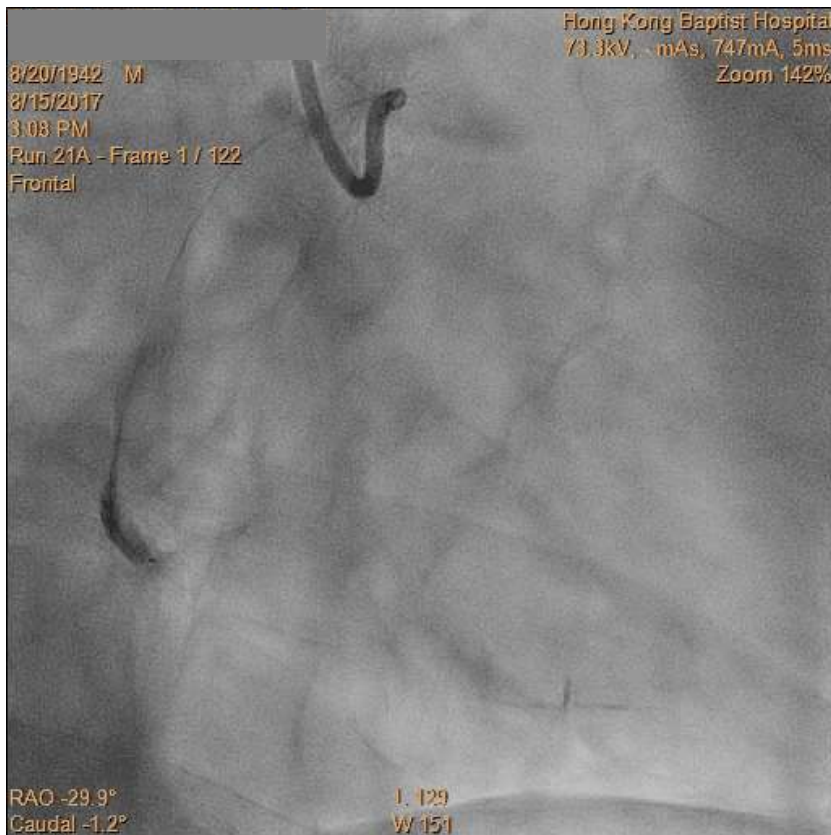
**LAO: Gaia 2<sup>nd</sup> rotating  
freely**



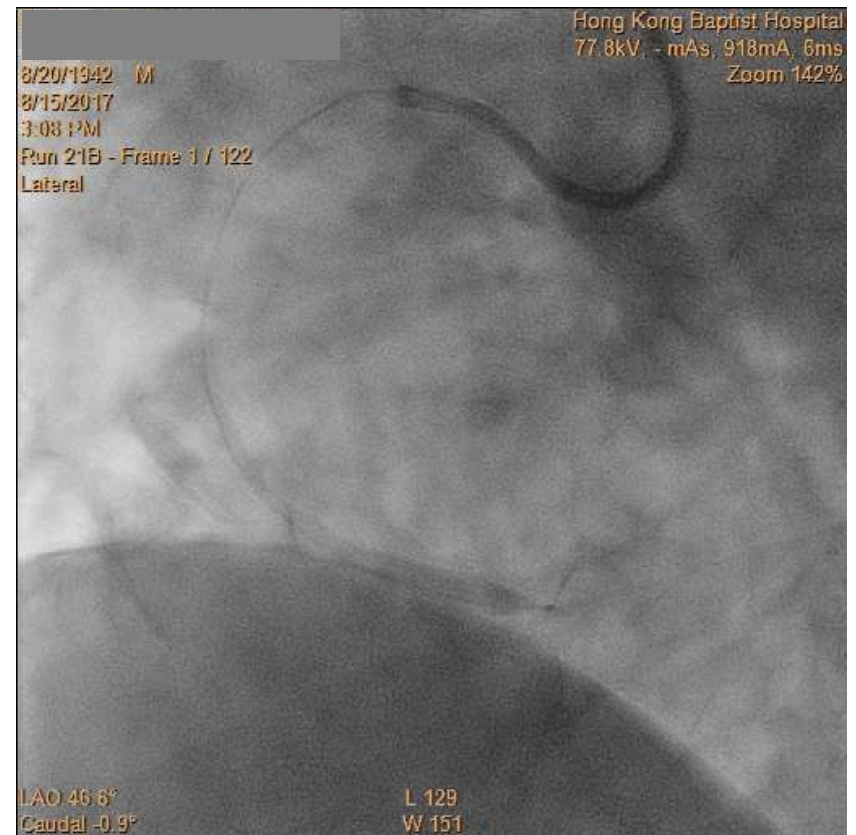


# PCI for RCA CTO : Contrast injection at Finecross

**RAO: Confirmed true lumen distal to CTO**

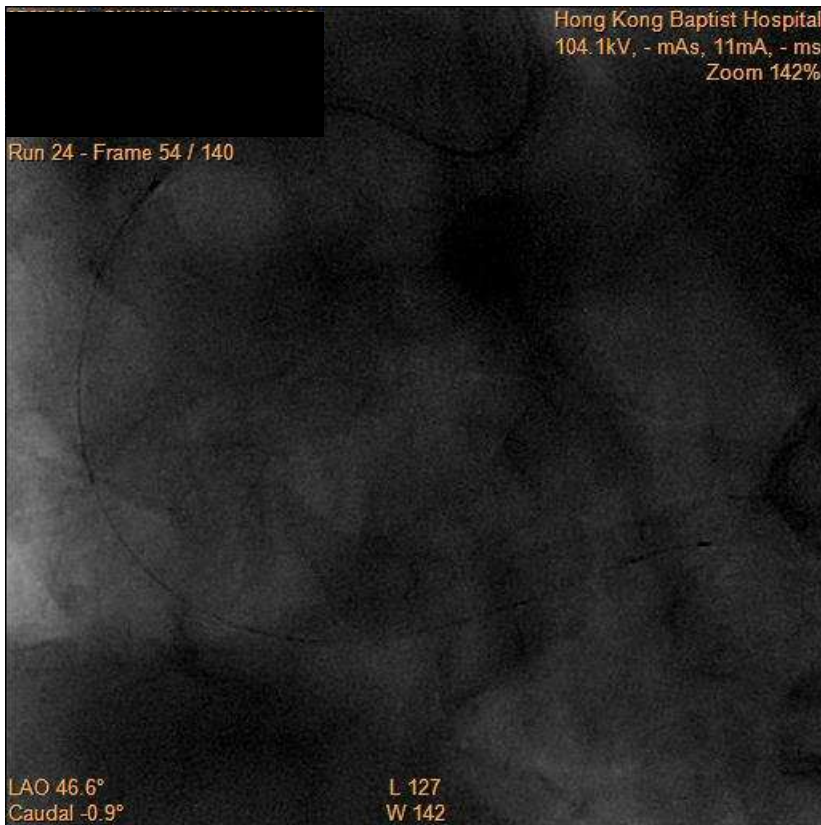


**LAO: PLV did not show up**



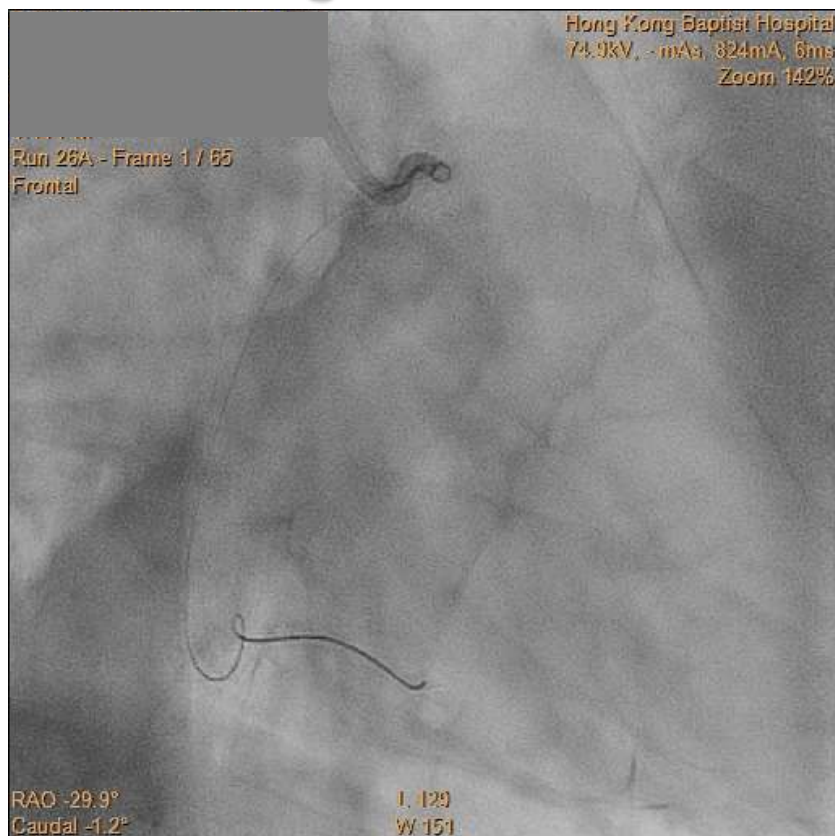
# PCI for RCA CTO : POBA to p-mRCA

**RAO: POBA to p-mRCA  
by 1.5mm balloon**

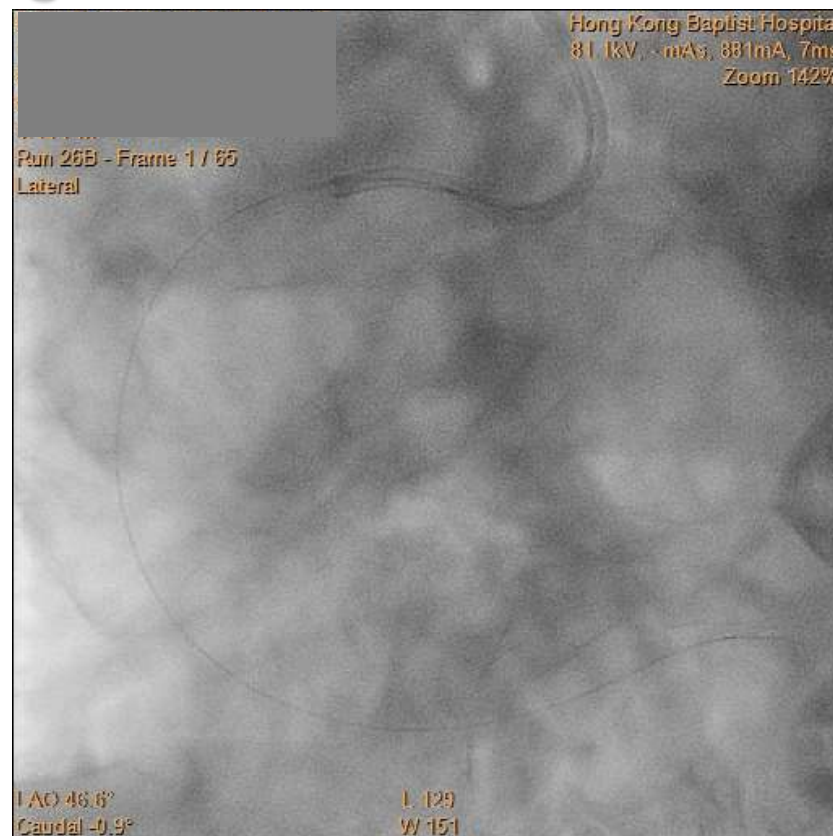


# PCI for RCA CTO : Angiogram suspected PLV disease

**RAO: Large RV branch**



**LAO: Still distal flow not good**



# PCI for RCA CTO : POBA to p-mRCA

## POBA to p-mRCA by 2.5mm balloon

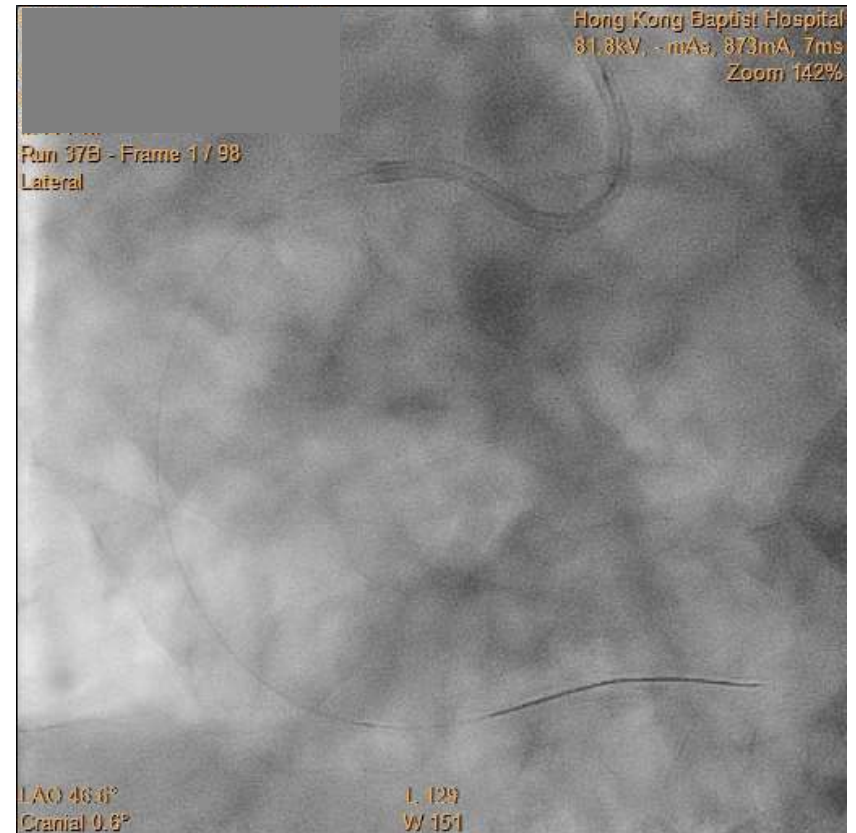


# PCI for RCA CTO : Angiogram showed PLV disease

**RAO:**

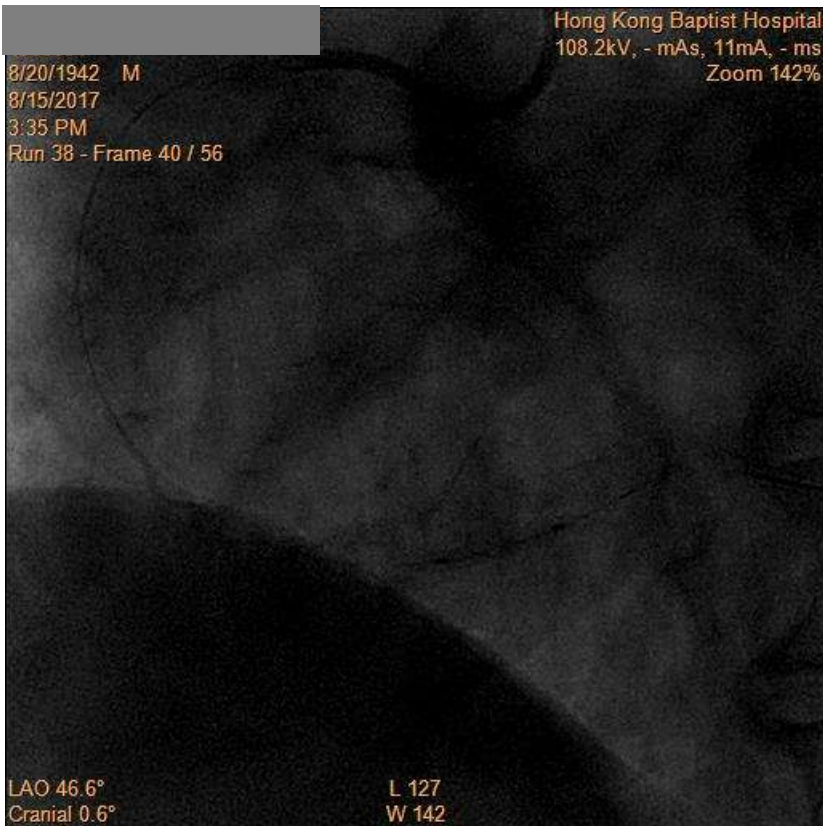


**LAO: significant PLV disease**



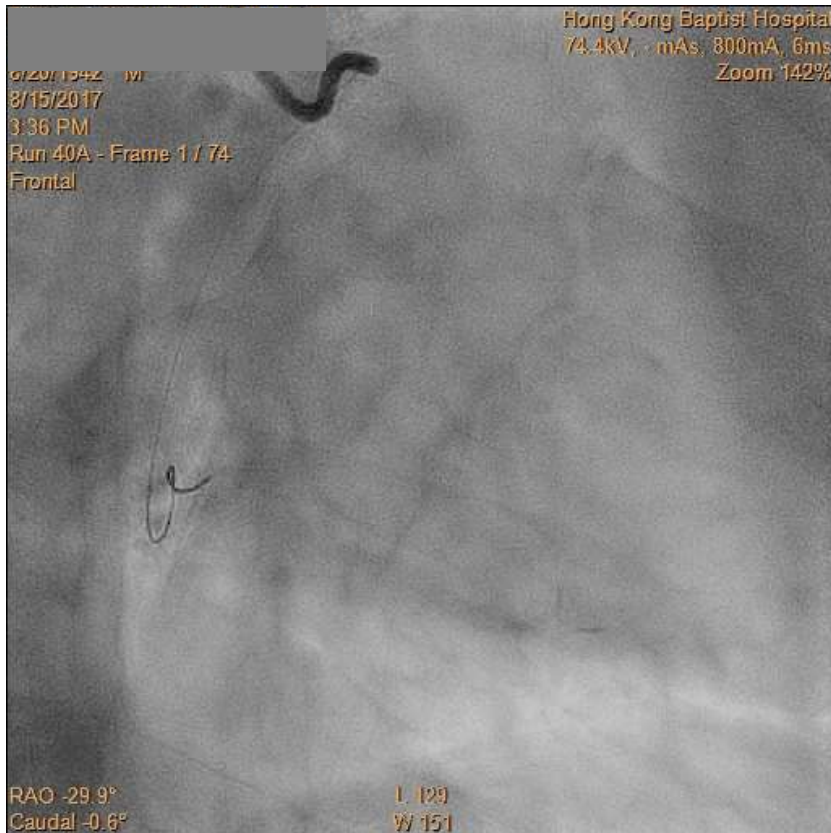
# PCI for RCA CTO : POBA to PLV

## POBA to PLV by 2.5mm balloon

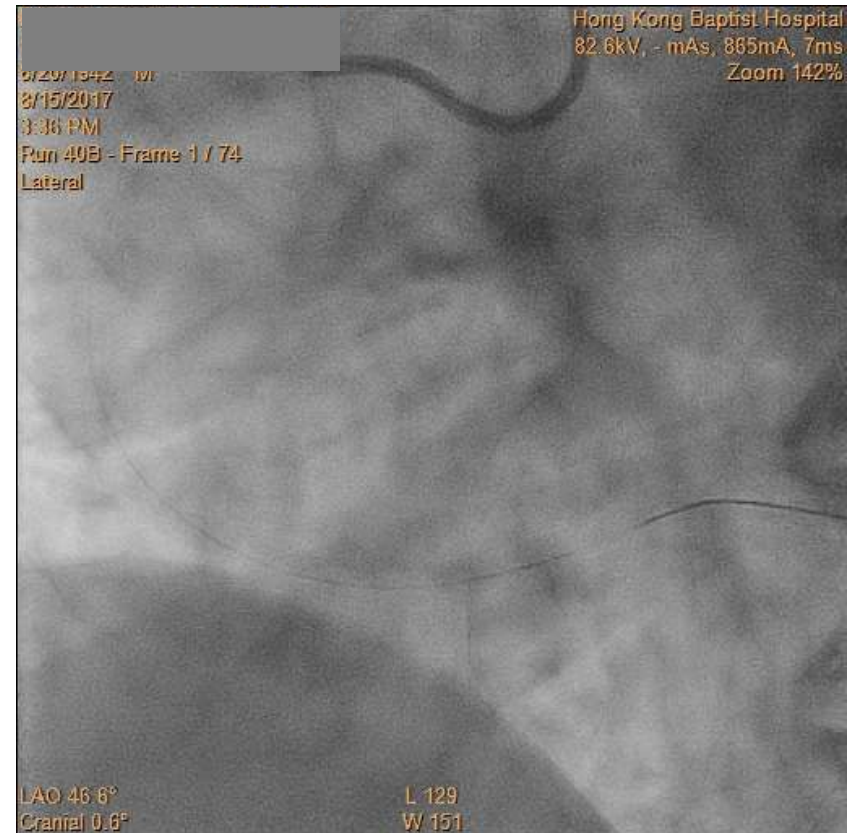


# PCI for RCA CTO : Angiogram before stenting

**RAO: Collateral to LAD seen**



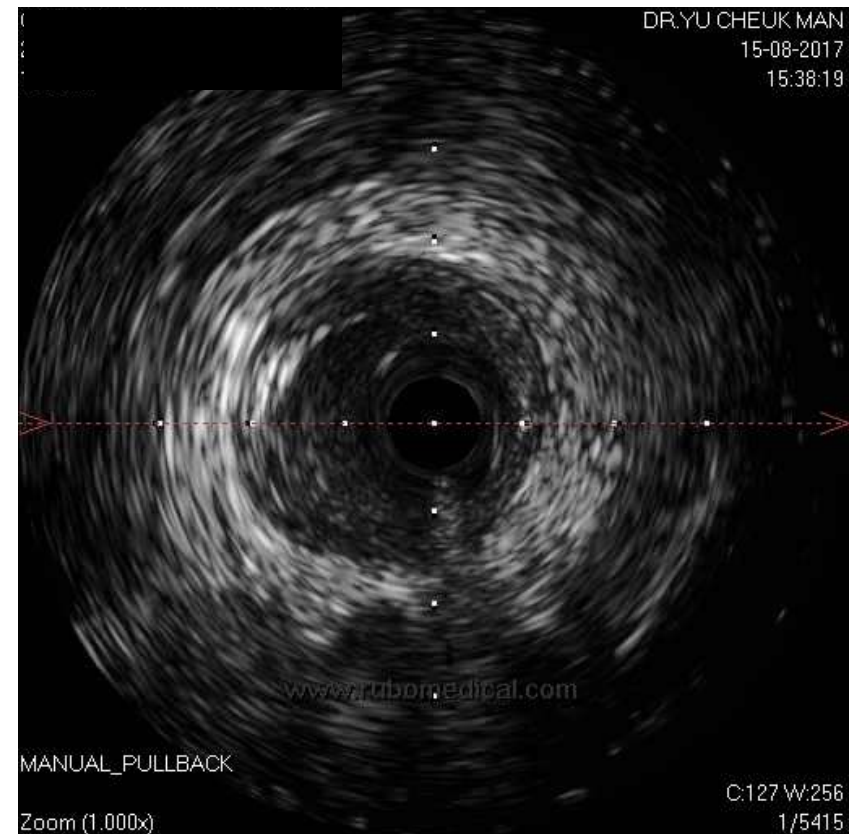
**LAO: Regain good RCA flow**



# PCI for RCA CTO : IVUS guided stenting

## IVUS by OptiCross (BS)

- Guidewire in true lumen for the whole course
- Determine sizing of stents





# PCI for RCA CTO : Stenting to PLV

**PLV by 3.0x24mm  
BioFreedom**

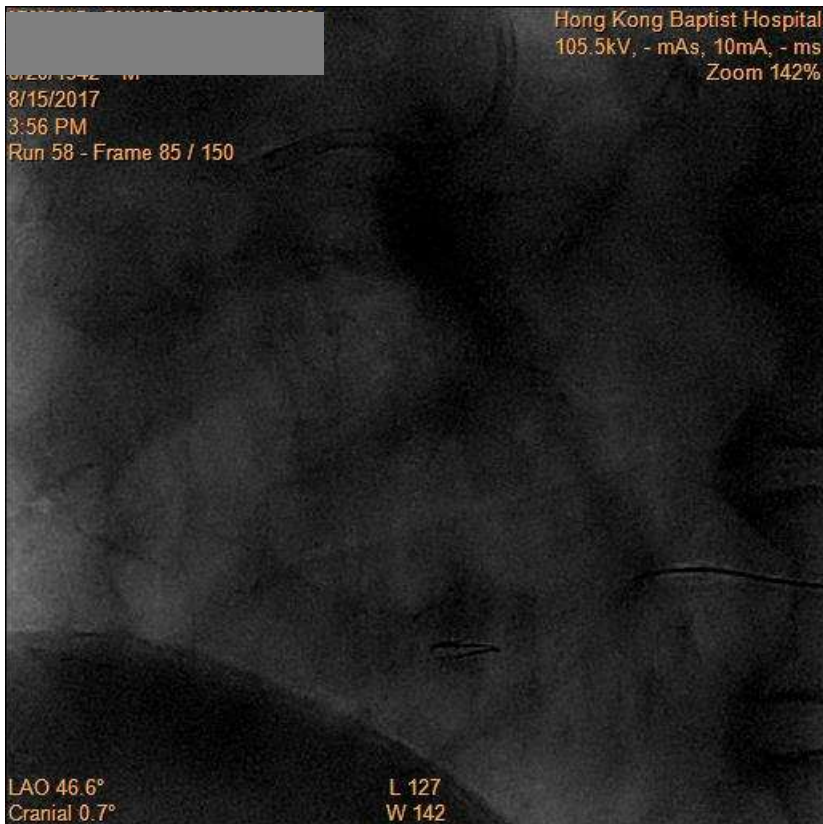


**Post-dilate PLV by 3.0x13mm  
NC balloon up to 18 atm**

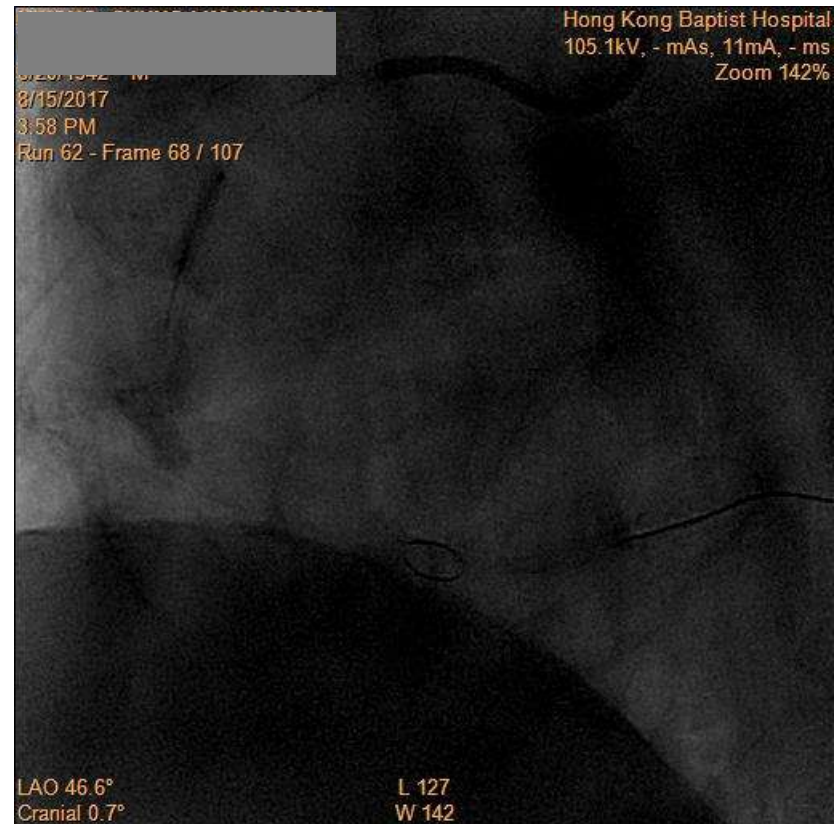


# PCI for RCA CTO : Distal protection by Filter Wire, the POBA to p-mRCA

**Filter Wire deployed at dRCA**



**POBA to p-mRCA by 3.0x13mm NC balloon up to 18 atm**

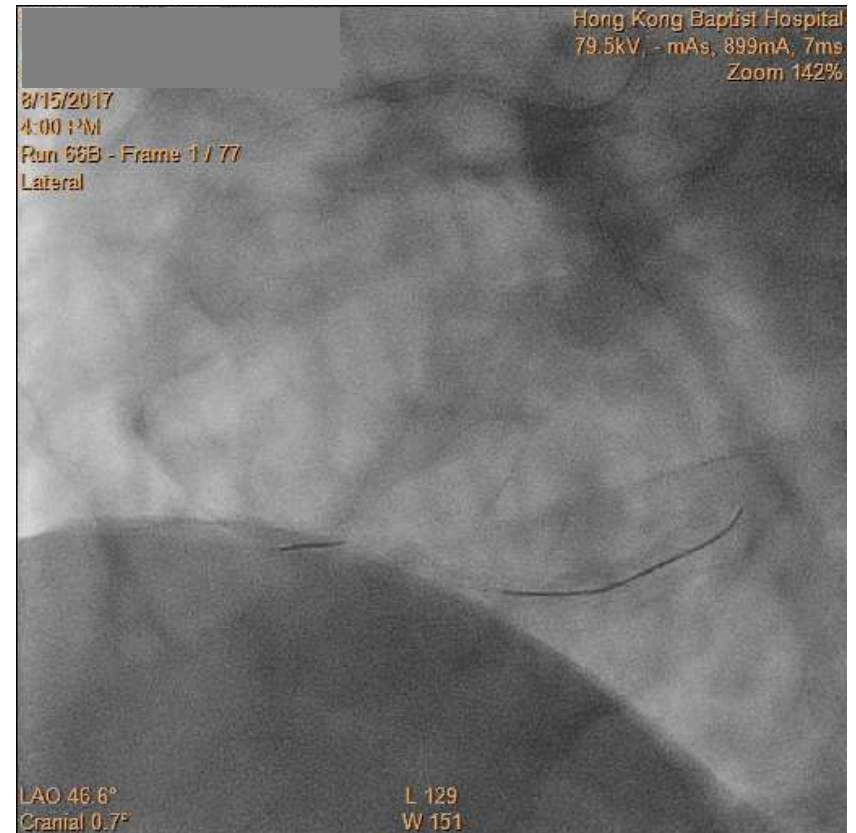


# PCI for RCA CTO : Angiogram

## RAO

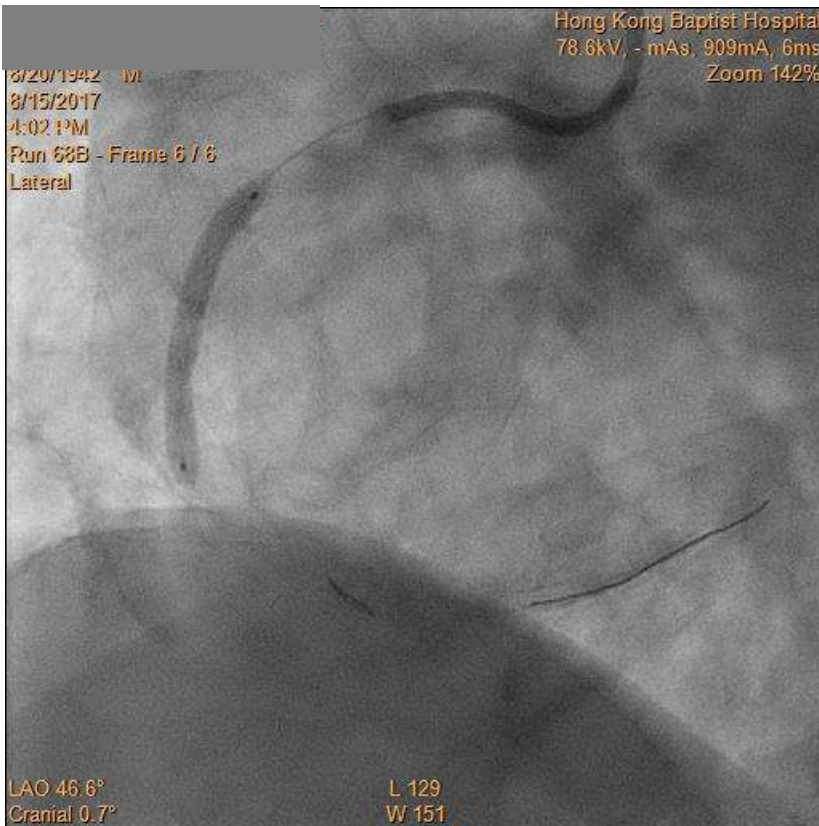


## LAO: Good flow at RCA

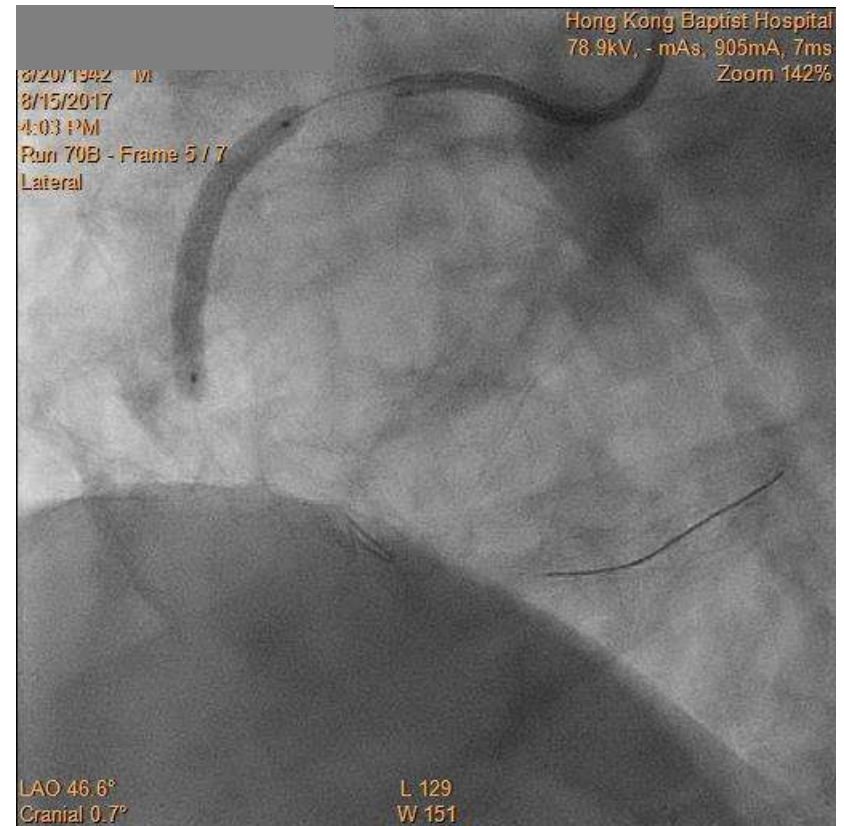


# PCI for RCA CTO : Stenting to p-mRCA

**Stent: 3.5x36mm  
BioFreedom at 10 atm**



**Stent balloon at 14 atm**

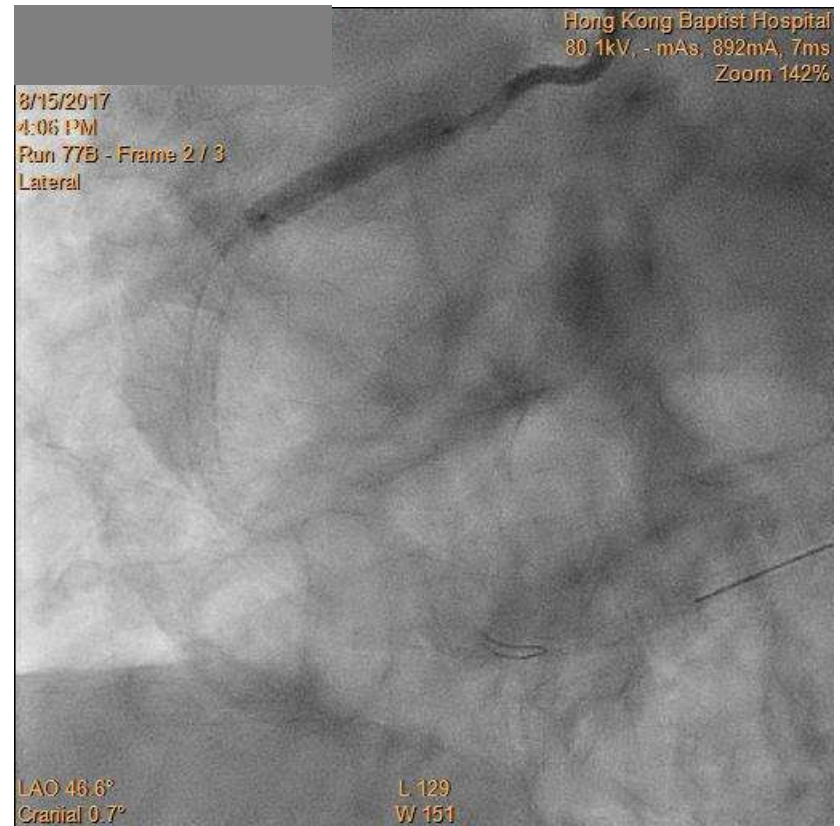


# PCI for RCA CTO : Stenting to pRCA

## LAO: Stent positioning

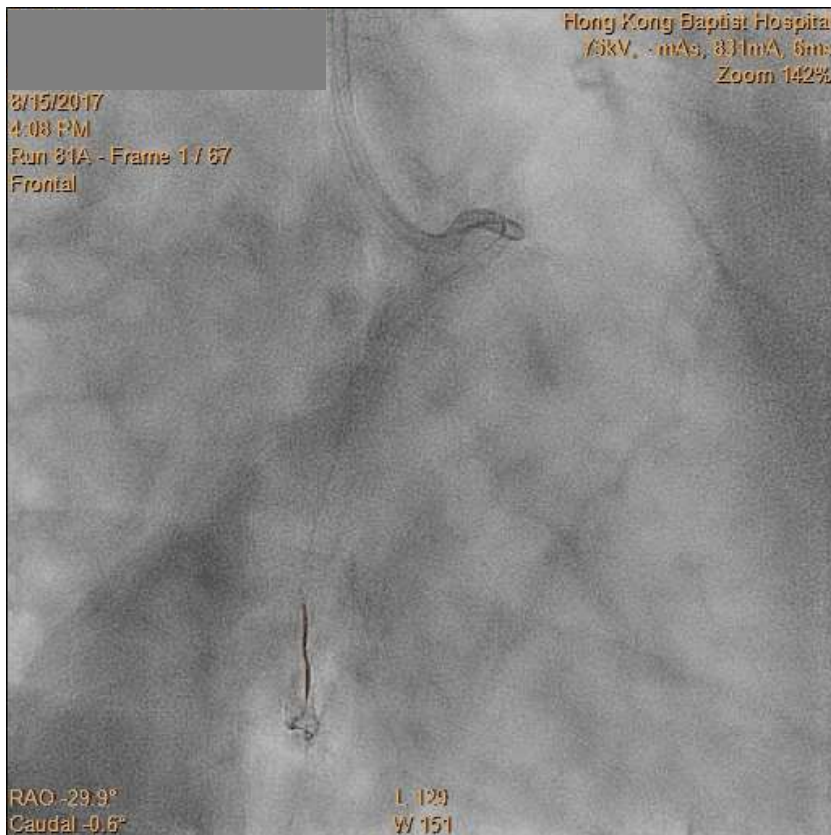


## Stent: 4.0x24mm BioFreedom at 10 →13 atm

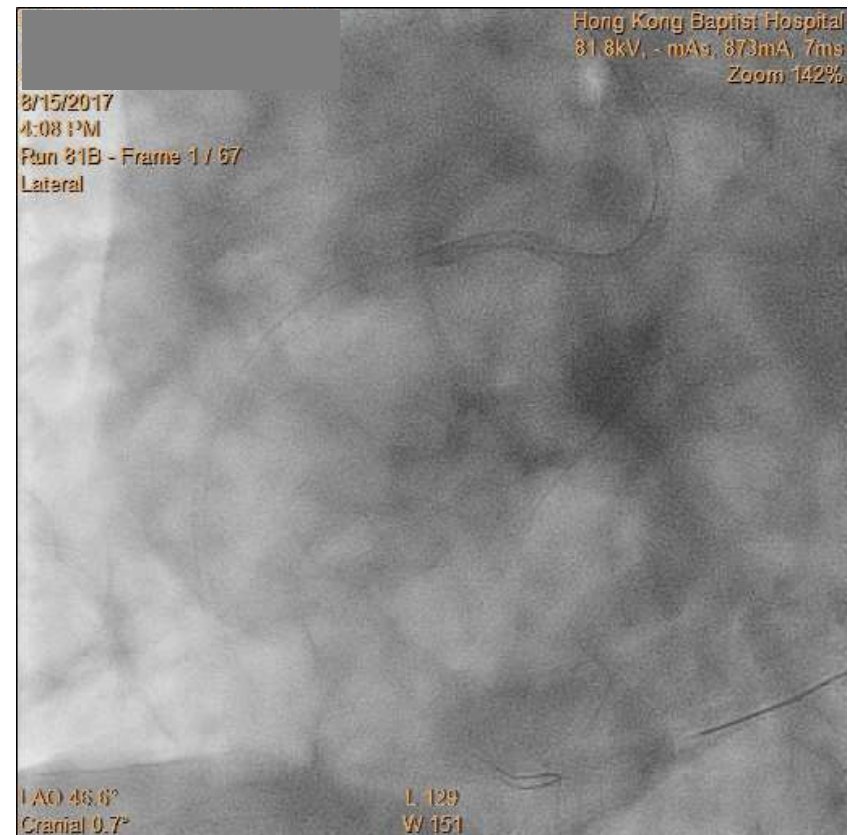


# PCI for RCA CTO : Angiogram after Stenting to p-mRCA

## RAO

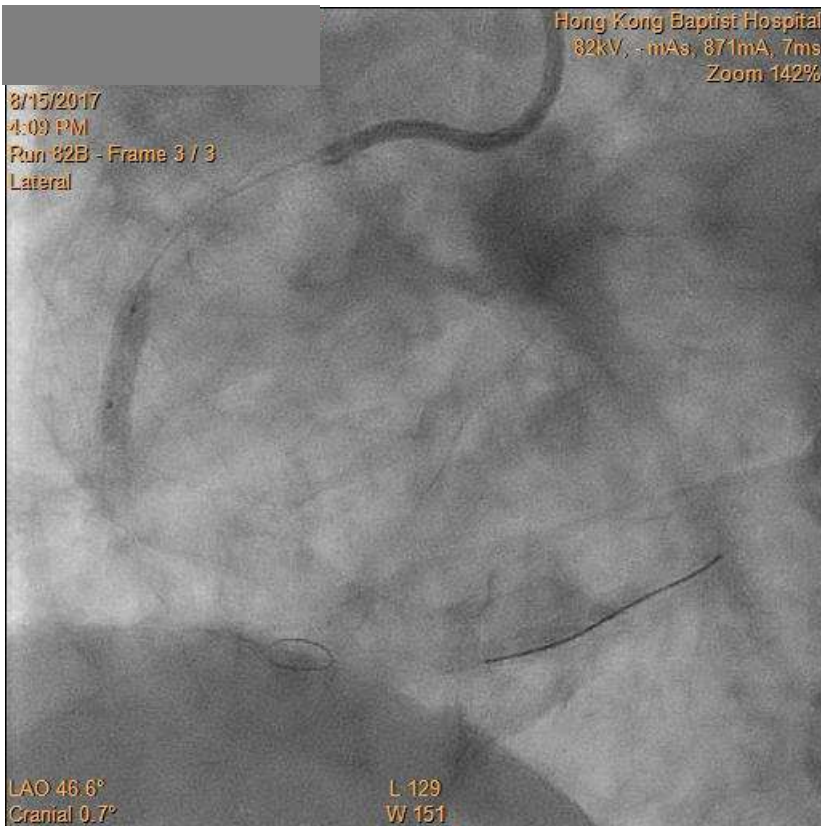


## LAO



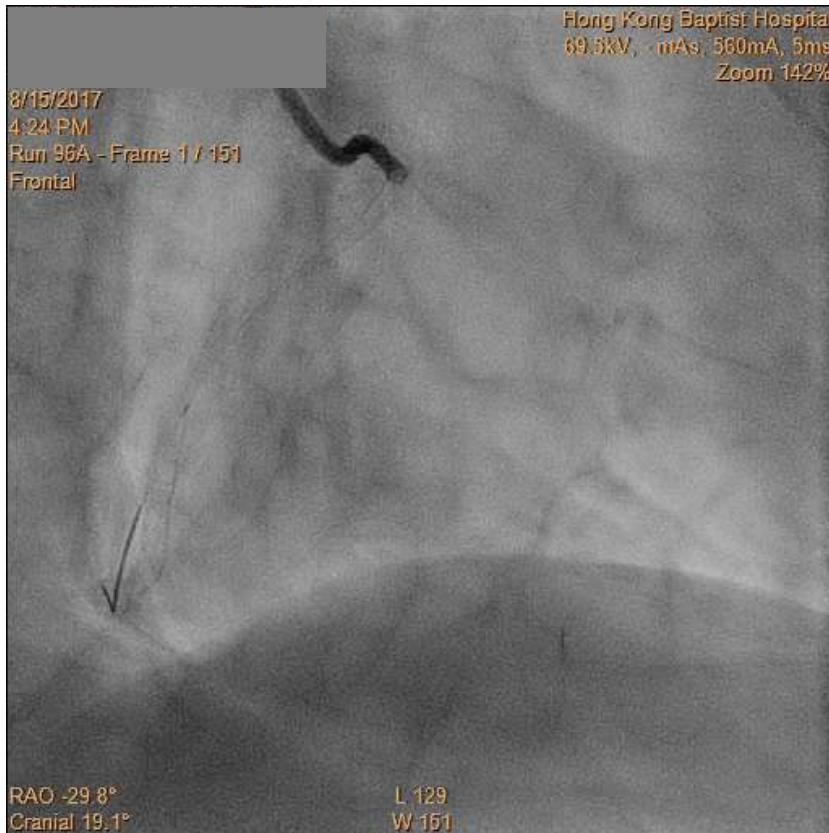
# PCI for RCA CTO : Post-dilate RCA stents

By 4.0x13mm NC balloon  
up to 18 atm

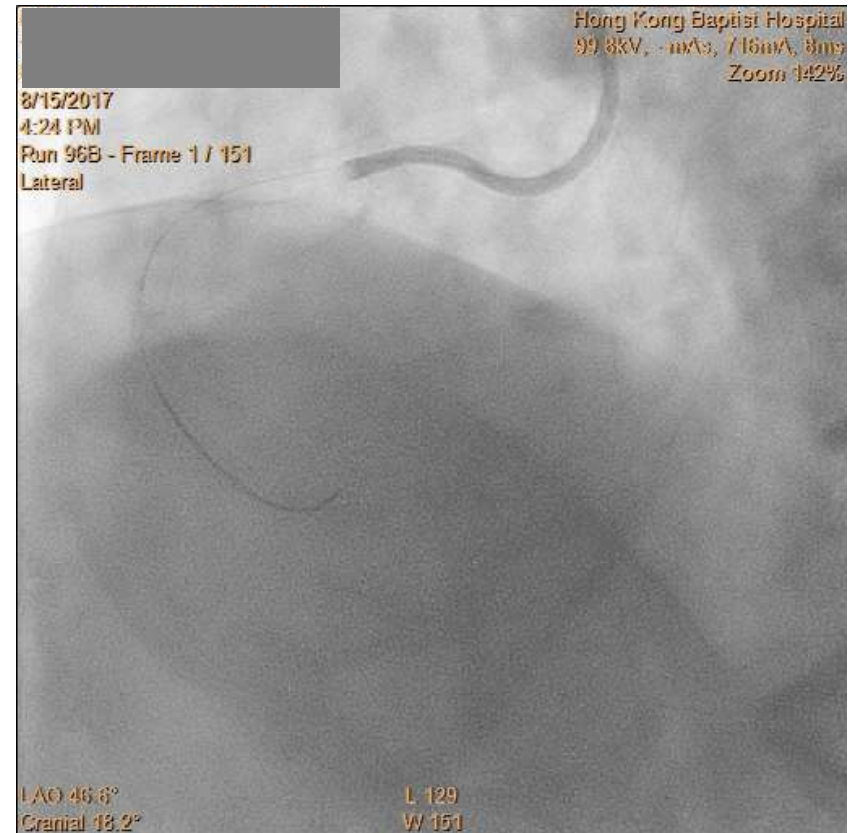


# PCI for RCA CTO : Final Angiogram

**RAO: Retrograde  
Collaterals to LAD**



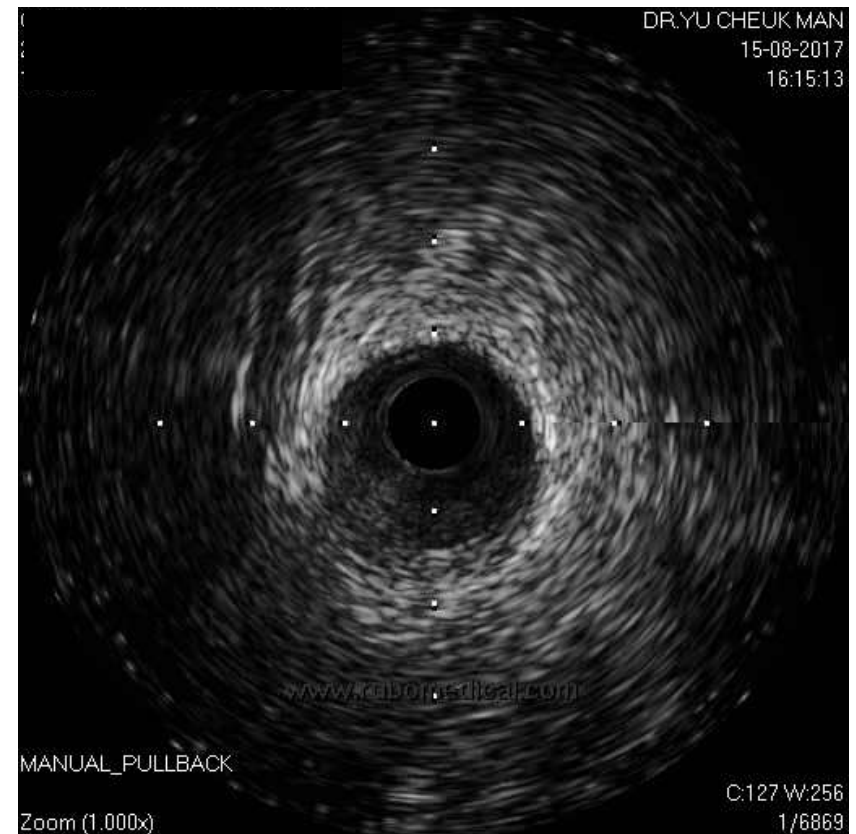
**LAO: TIMI 3 flow, all  
branches preserved**





# PCI for RCA CTO : Final IVUS to RCA

- Excellent stent expansion and apposition
- No subintimal tract





# Progress Post-PCI

- Temporary hemodialysis-F support at dialysis centre on 15-8-2017
- Creatinine peaked at  $256\mu\text{mol/L}$  (17-8-2017), then decrease to about  $190+\mu\text{mol/L}$
- Stable control for HF symptoms, euvolumic
- Stable BP, pulse & H'stix
- Staging PCI to LAD CTO (suspected double CTO) 4 days later

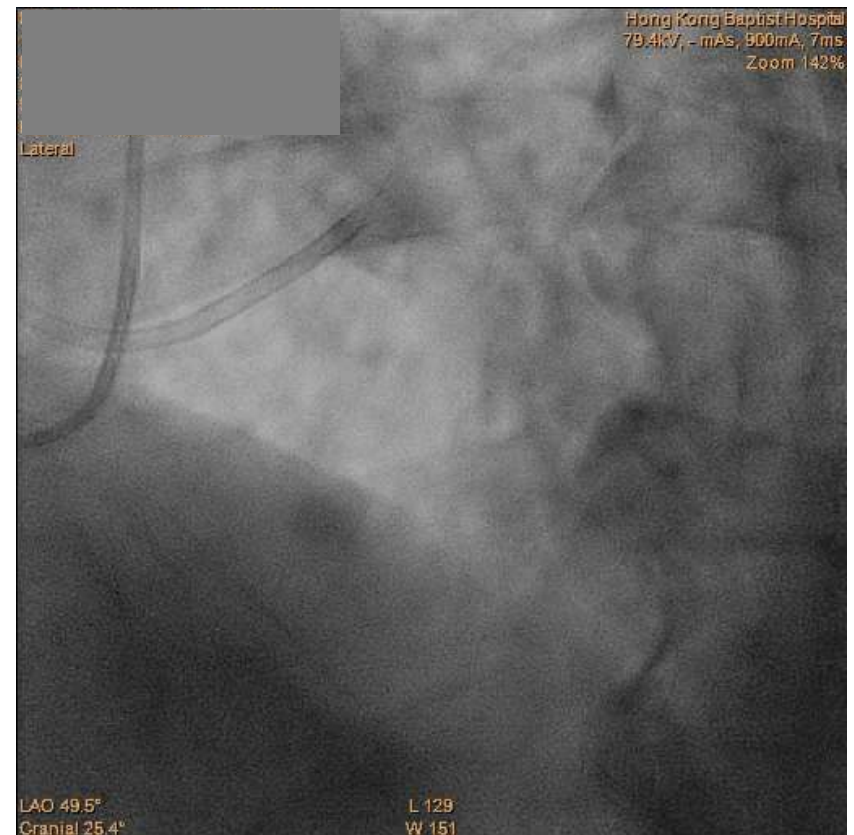
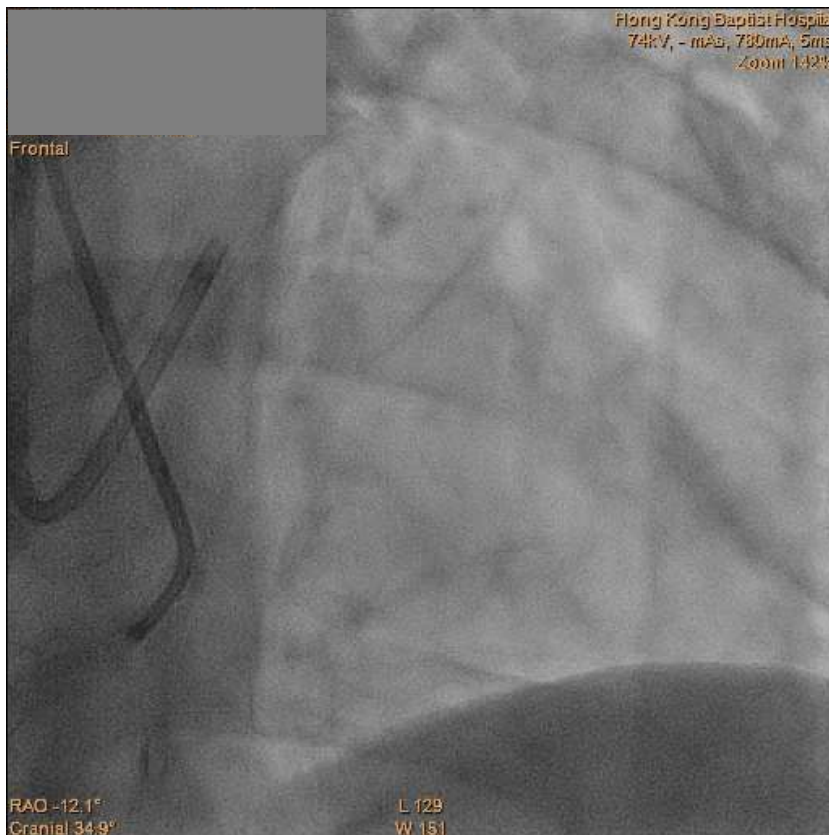


# PCI to LAD: double CTO at proximal & distal LAD

R radial x Guider: EBU 4

→ XB 4, 7F; better support

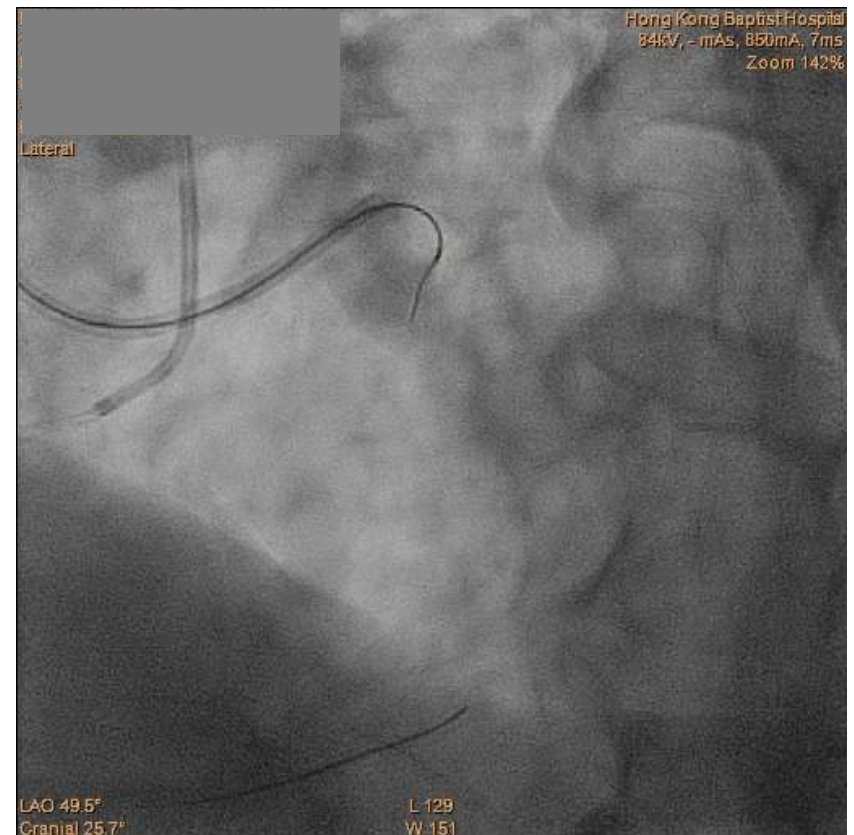
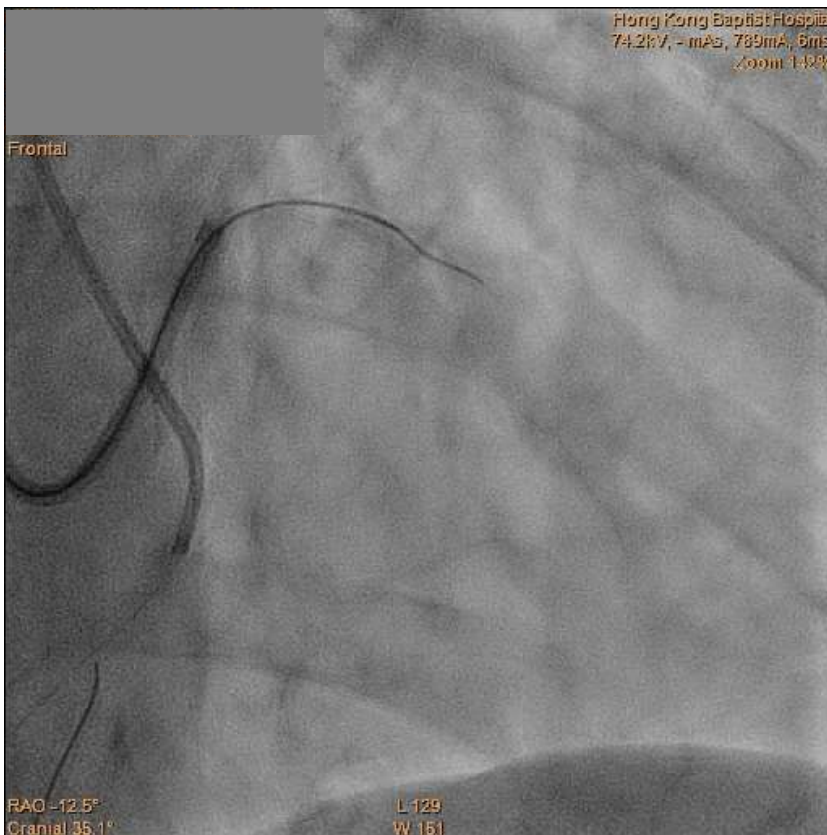
L radial x JR 5



# PCI to LAD: Caravel with XTa

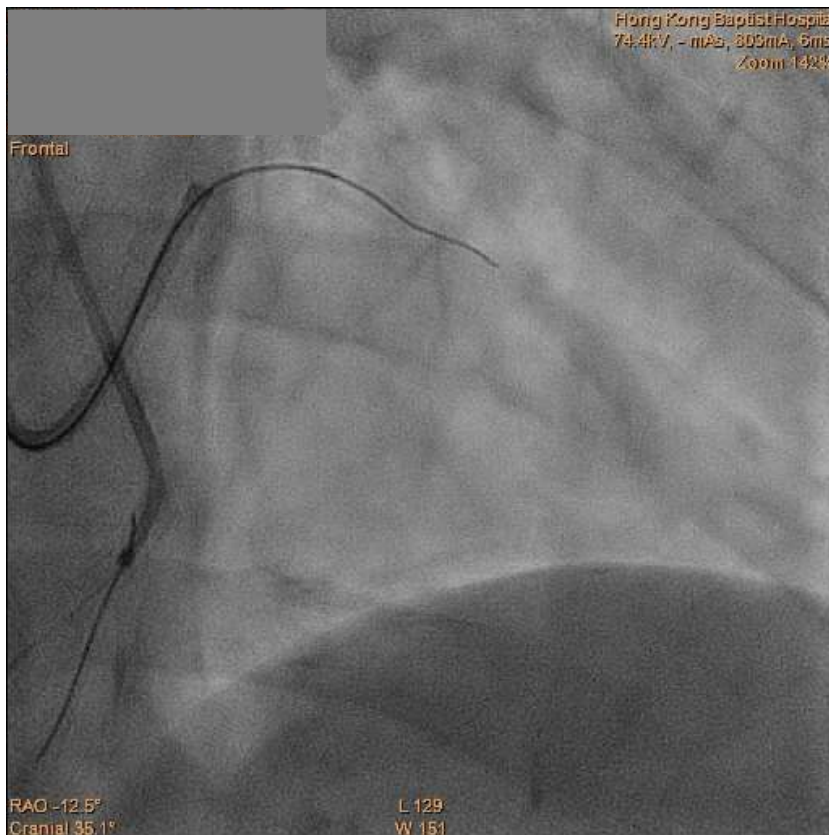
MC: Caravel; GW: XTa

Attempting to cross 1<sup>st</sup> CTO, but failed

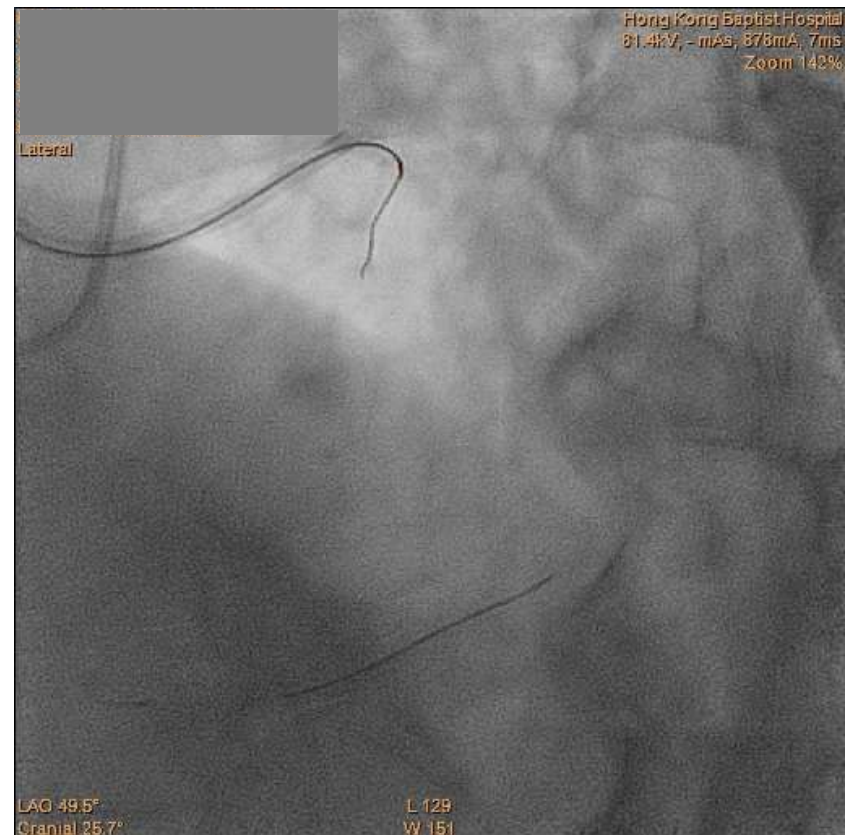


# PCI to LAD: Caravel with Gaia 1<sup>st</sup>

A few attempts, Gaia 1<sup>st</sup> in good progress towards CTO

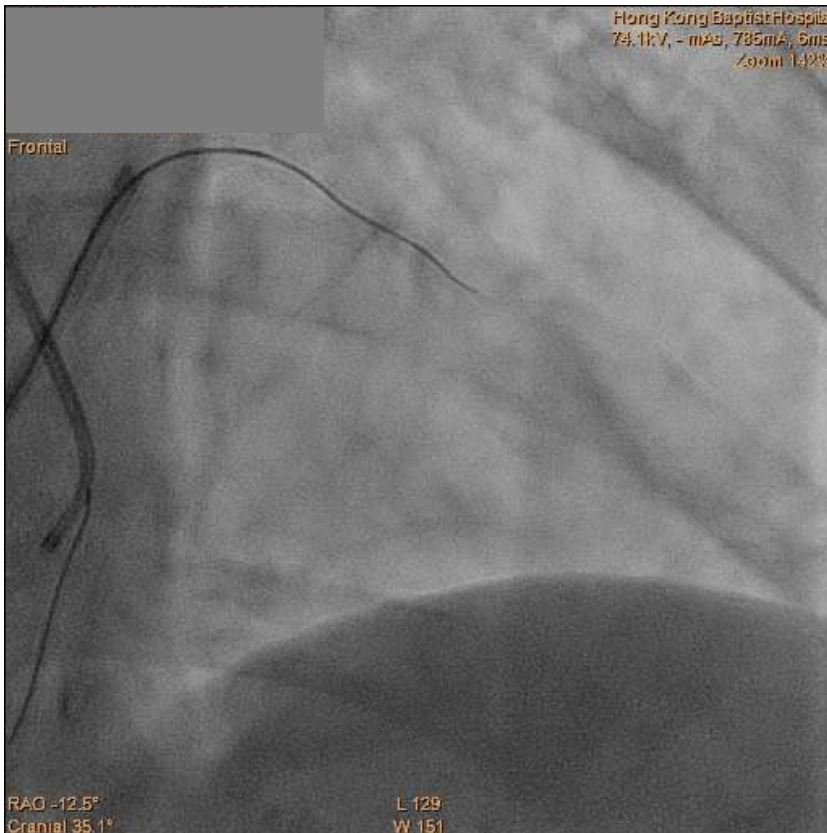


Retrograde injection to confirm Gaia 1<sup>st</sup> position

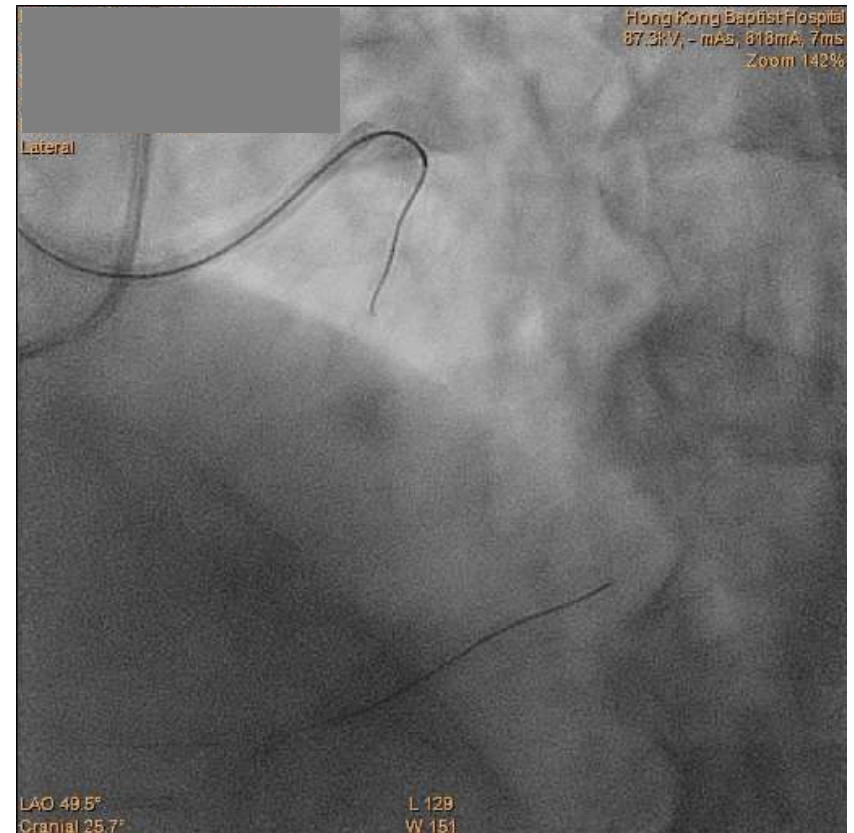


# PCI to LAD: Caravel failed to cross pLAD CTO

**Gaia 1<sup>st</sup> crossed pLAD CTO**

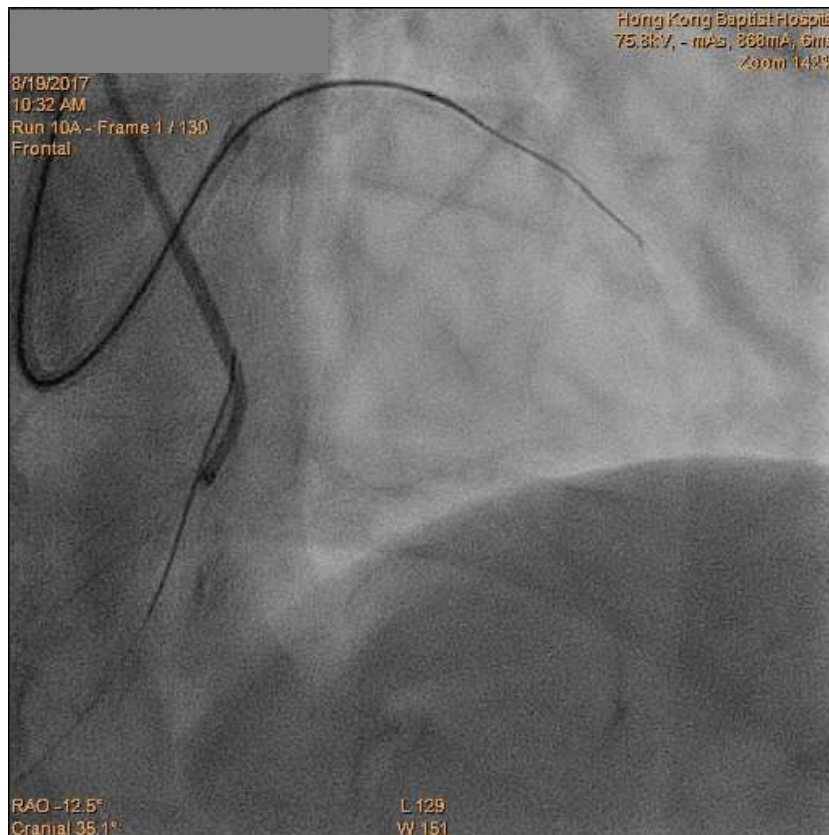


**But Caravel failed to cross pLAD CTO**



# PCI to LAD: Changed to Corsair, still failed

**Corsair with Gaia 1<sup>st</sup>**



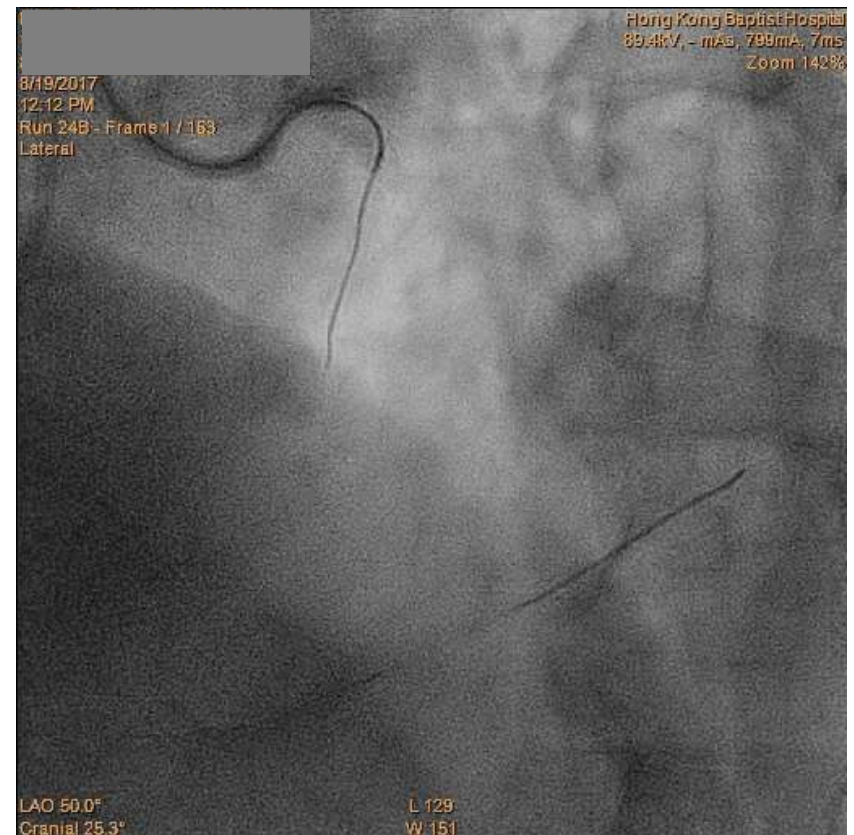
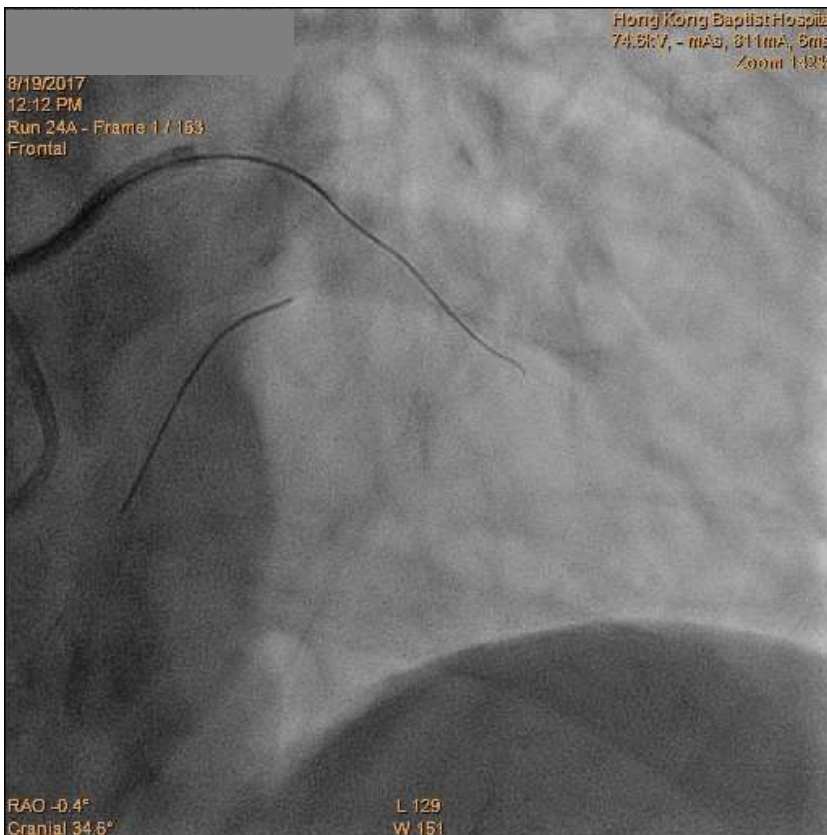
**Corsair still failed to cross pLAD CTO, inadequate Guider support**



# PCI to LAD: Changed Guider to AL1.5 7F

**Caravel with Gaia 1<sup>st</sup>,  
recrossed pLAD CTO**

**Caravel remain failed to cross  
CTO (better but still inadequate  
support!)**





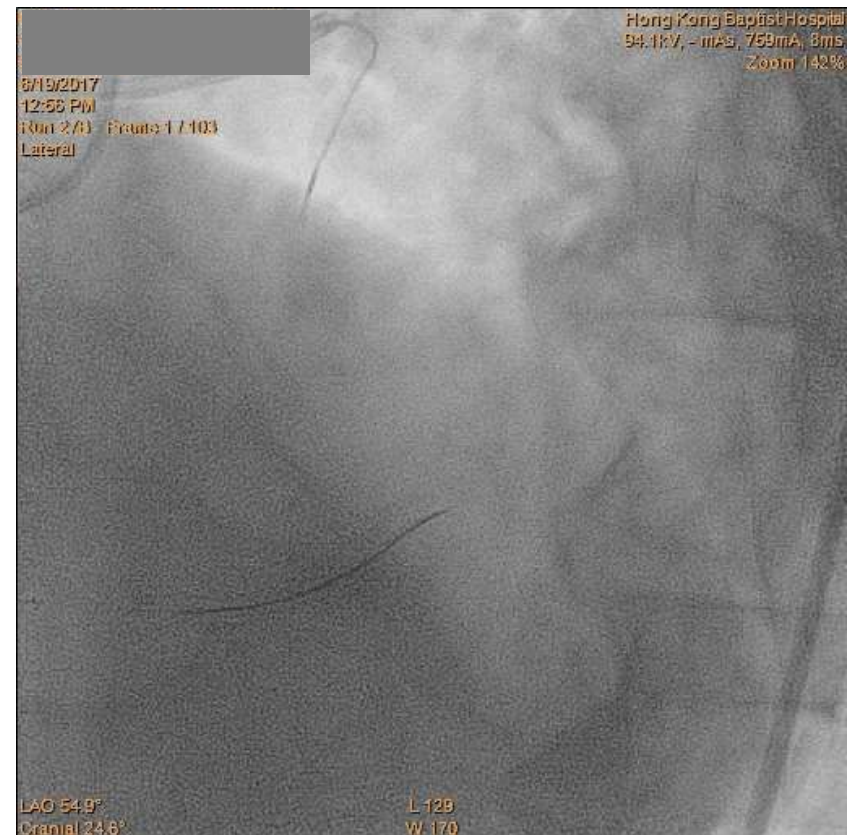
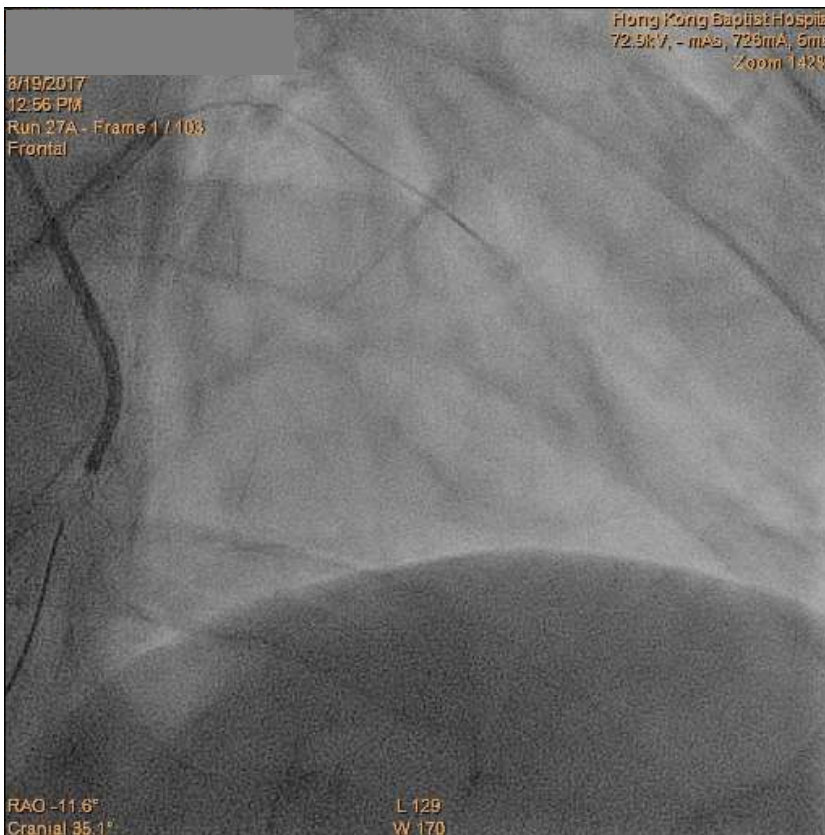
# PCI to LAD: Switched to R femoral approach

Guider: EBU 4.5 7F

Caravel and XTa, Caravel  
crossed pLAD CTO!

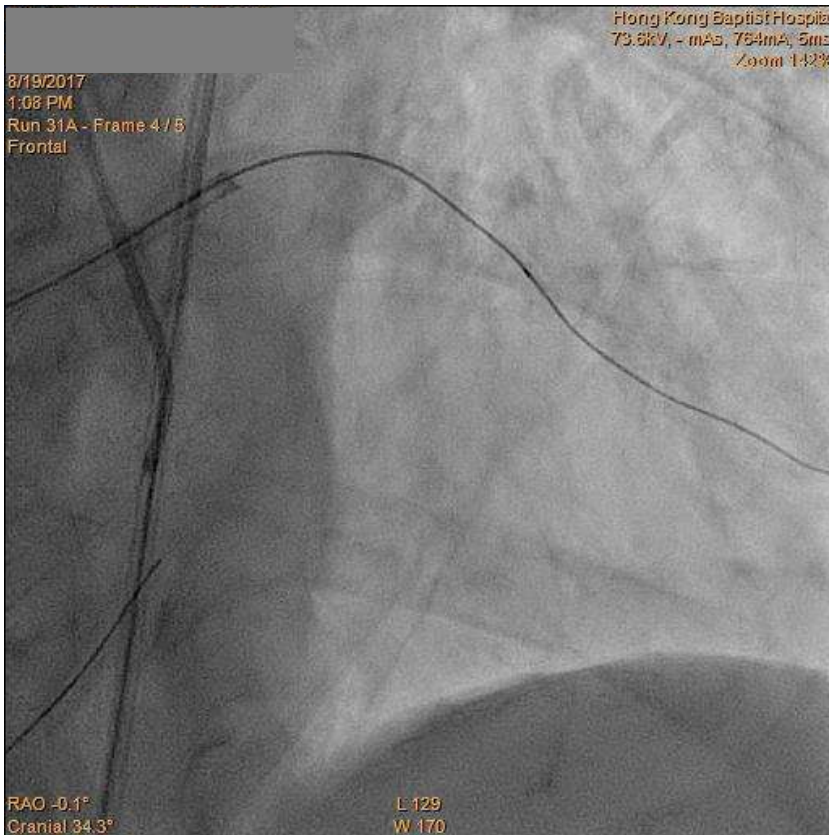
Angiogram via Caravel:

No stump at trifurcation to  
Diagonal and Septal

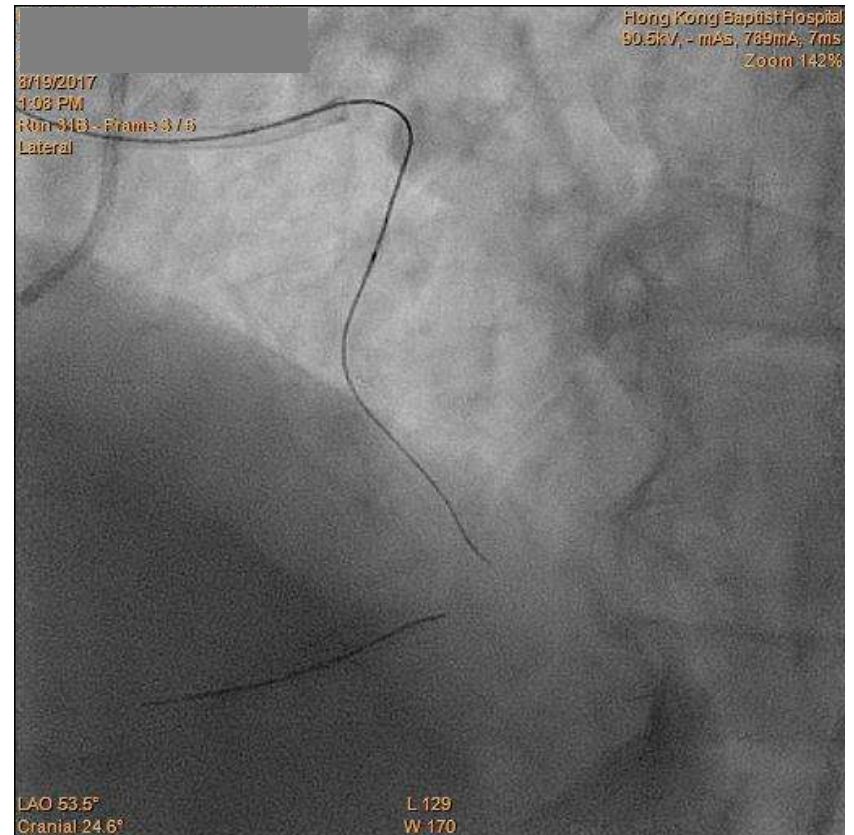


# PCI to LAD: POBA to p-mLAD

**XTa at D2 beyond pLAD CTO**

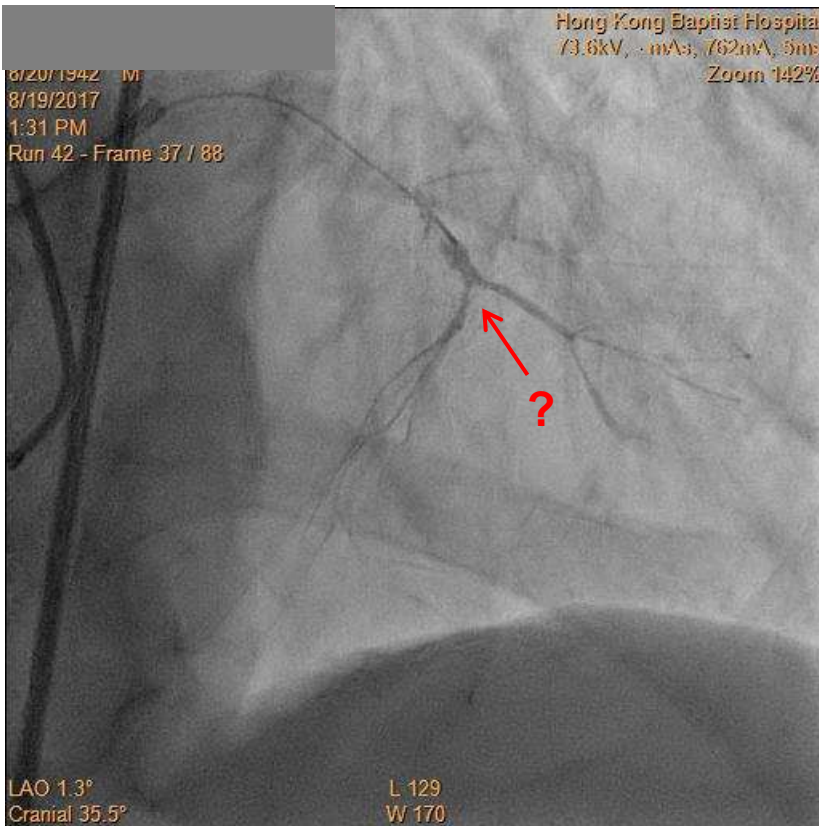


**POBA by 1.0x10mm @ 16 atm,  
then 1.5x10mm @ 12 atm**

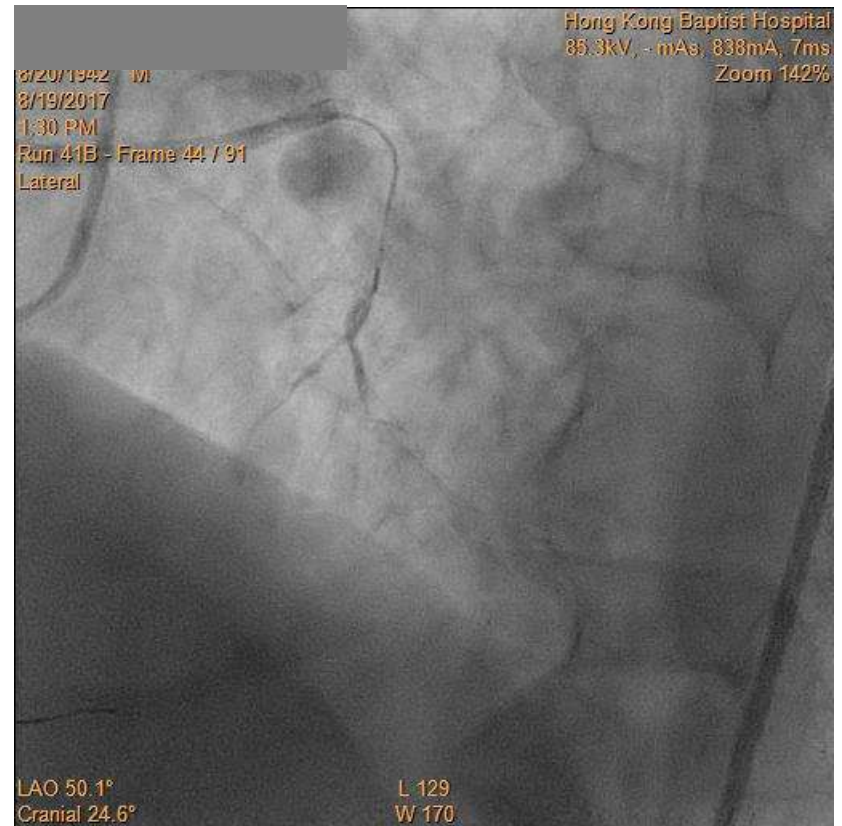


# PCI to LAD: Selective Angiogram at Caravel

**AP Cranial: no dLAD  
stump at trifurcation!**

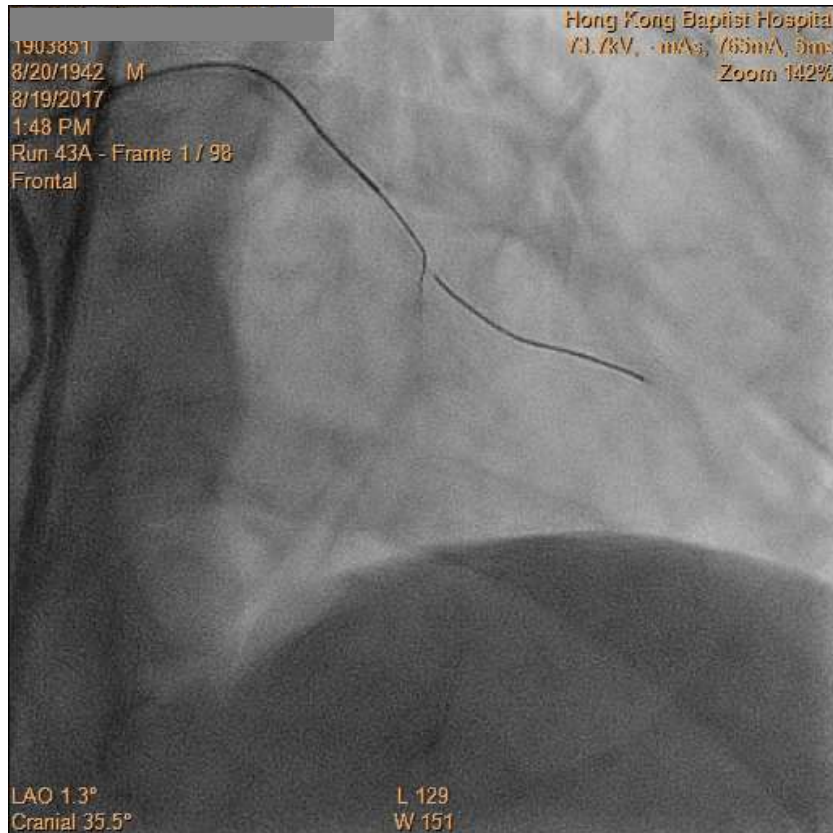


**LAO Cranial: no dLAD  
stump at trifurcation!**

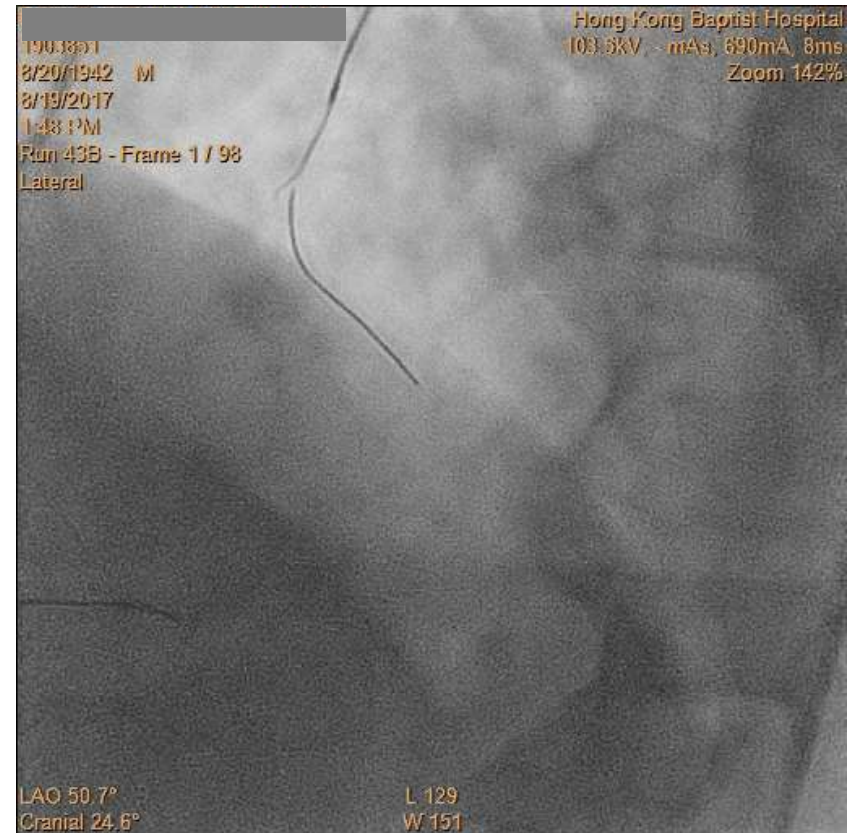


# PCI to LAD: Attempted to cross dLAD CTO

Caravel with XTa, then  
Gaia 1<sup>st</sup>, then Gaia 2<sup>nd</sup>



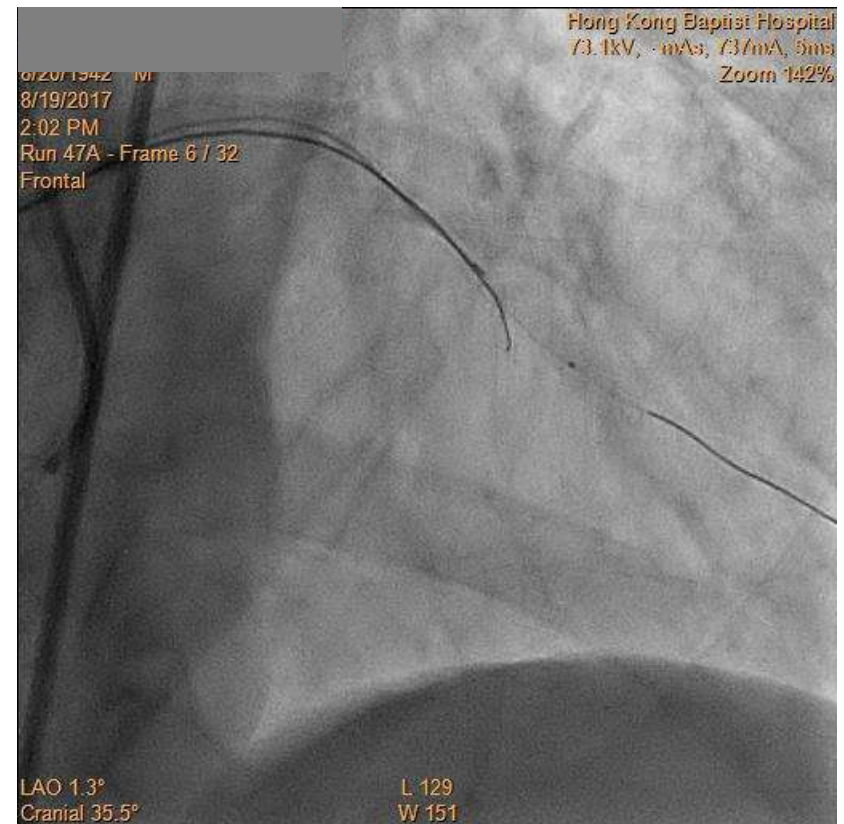
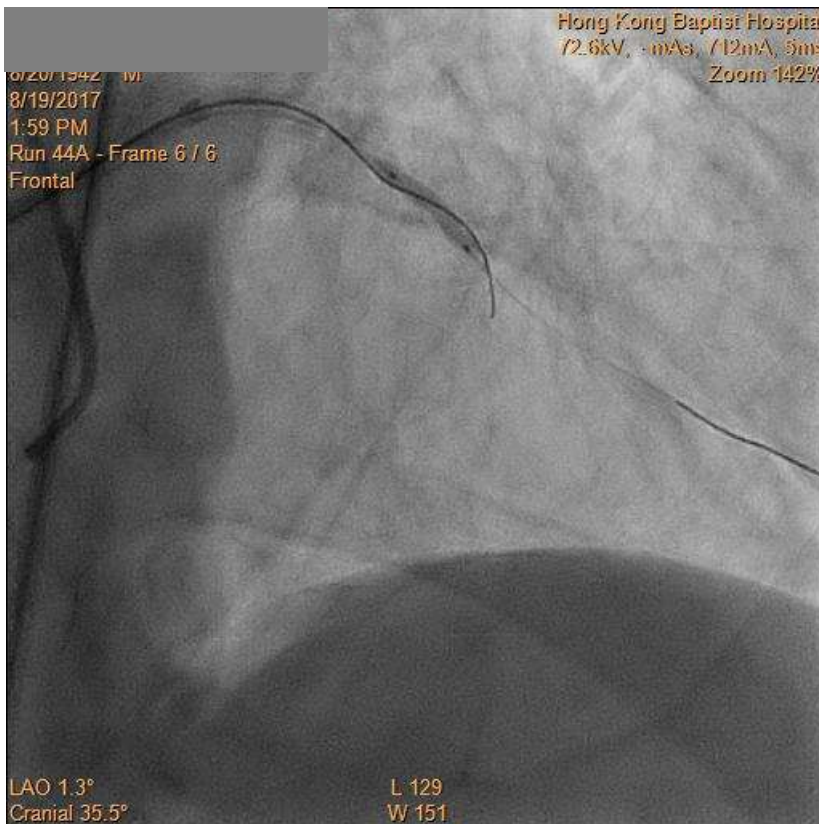
Unable to cross CTO



# PCI to LAD: POBA to p-mLAD then IVUS

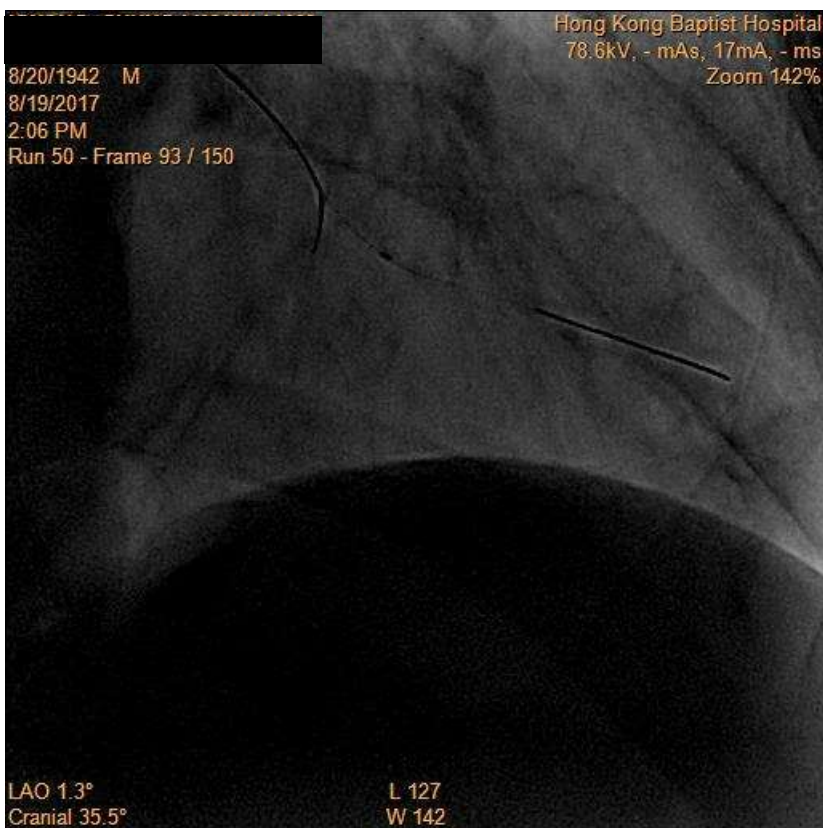
**POBA to p-mLAD by 2.5x15mm balloon @ 8 atm**

**IVUS at D2 to guide CTO wire, but D2 lesion and unable to pass catheter**

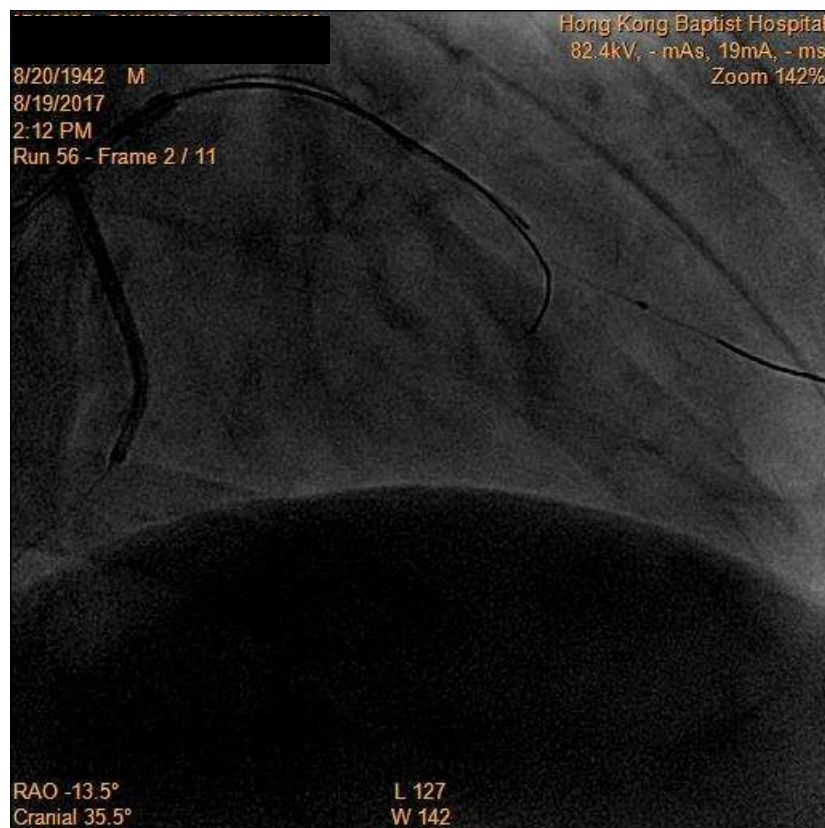


# PCI to LAD: POBA to D2

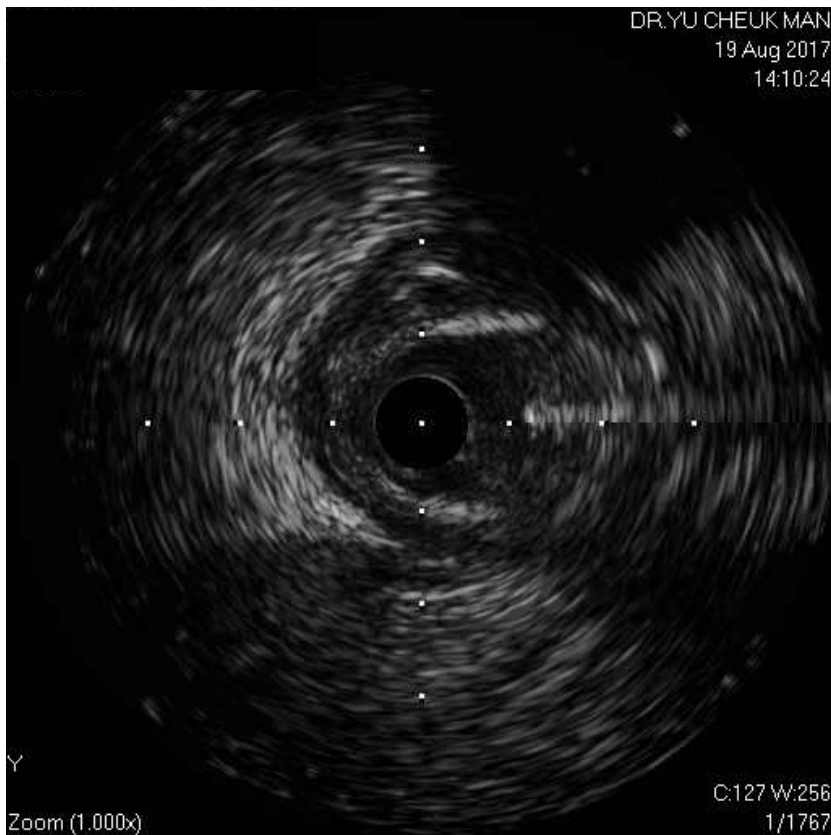
**POBA to D2 by 1.5x15mm  
@16 atm**



**IVUS able to pass to D2 to  
guide CTO GW**



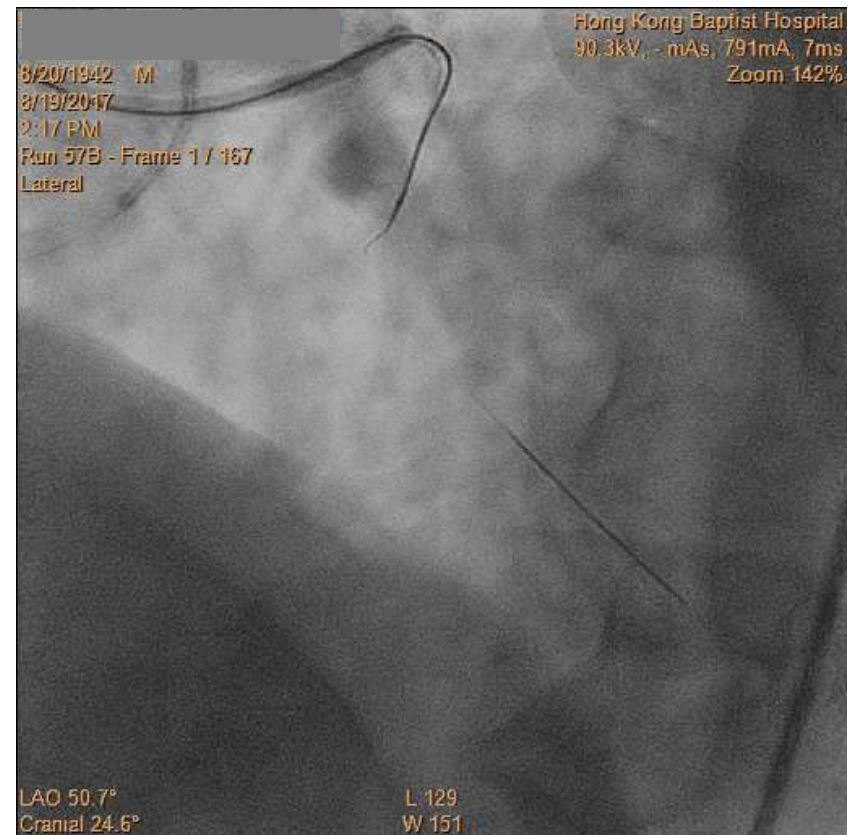
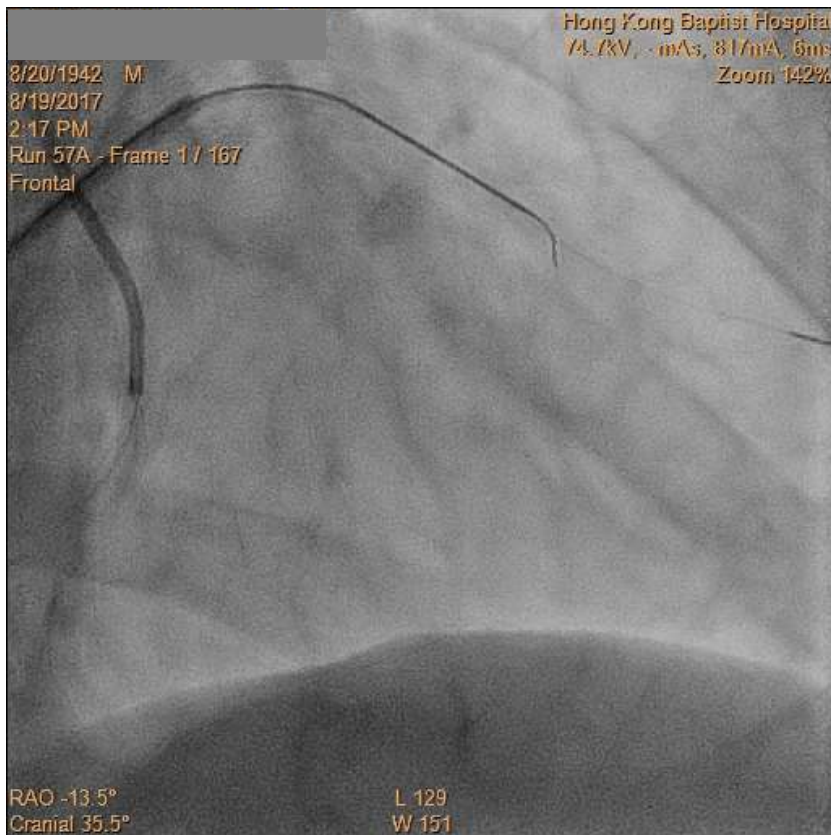
# PCI to LAD: IVUS at D2 to guide CTO entry



- IVUS: still unable to locate clearly the origin of dLAD
- Due to calcification?, or dLAD stump some distance beyond origin of D2?

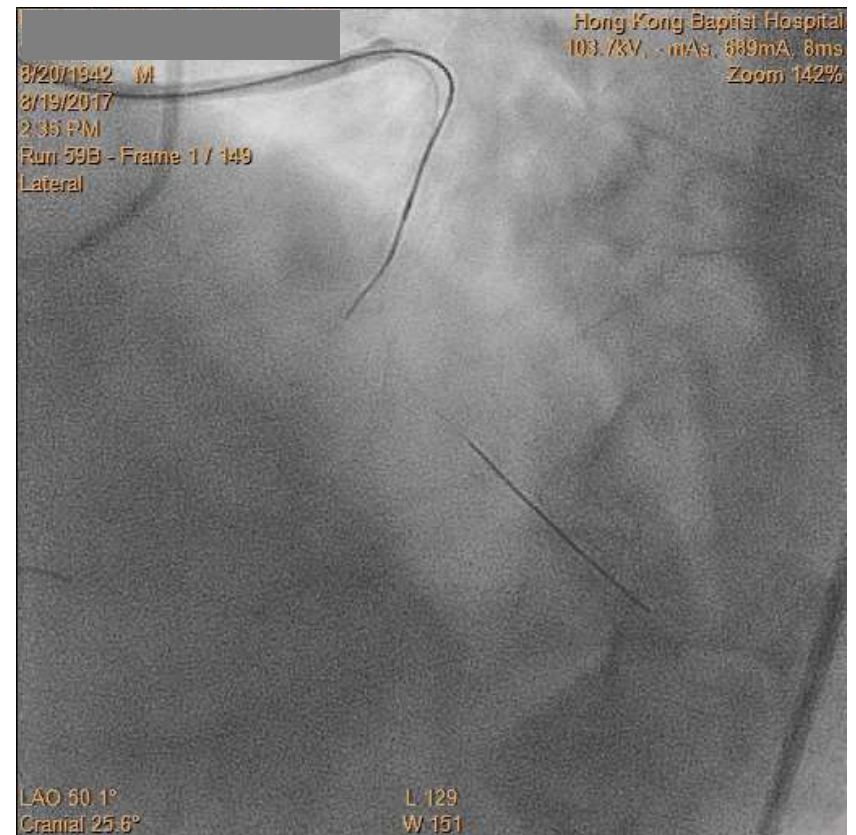
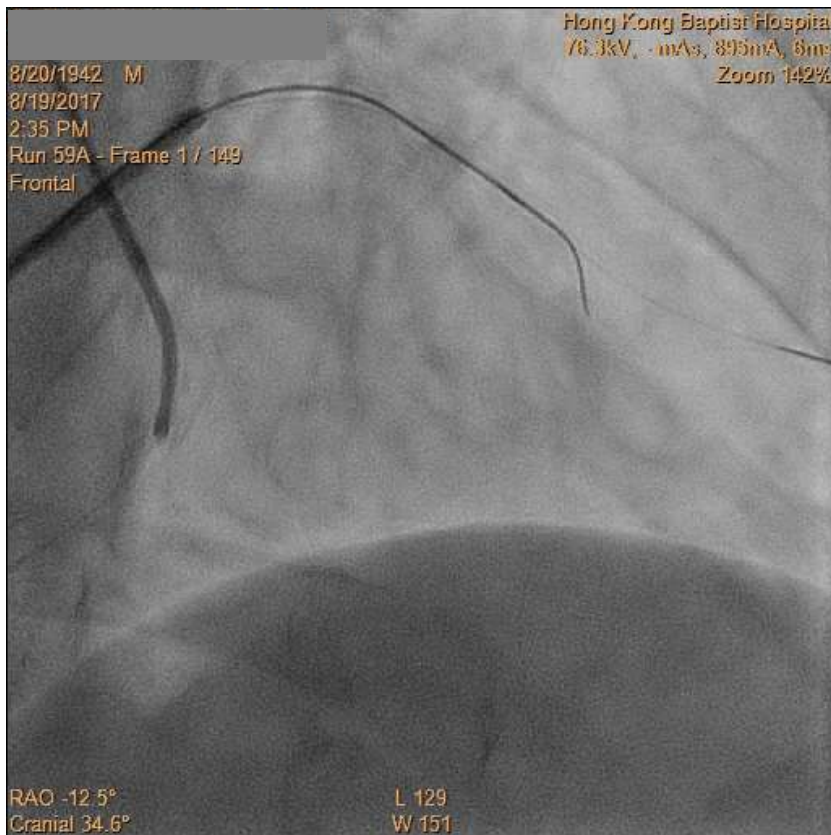


# PCI to LAD: Attempt to entry dLAD by Caravel and Gaia 3<sup>rd</sup>



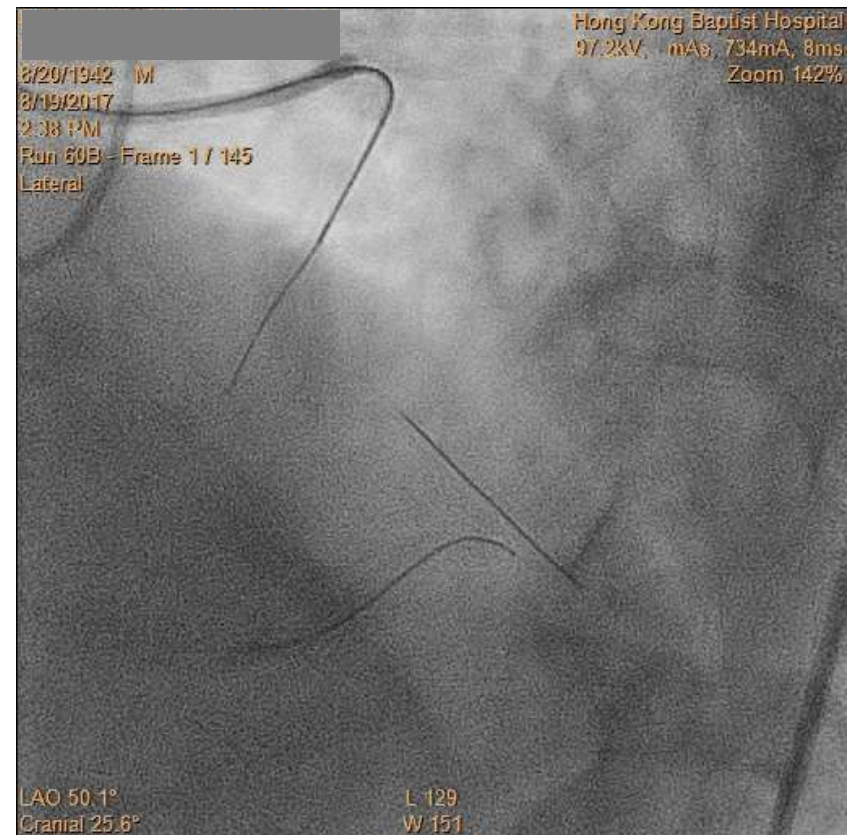
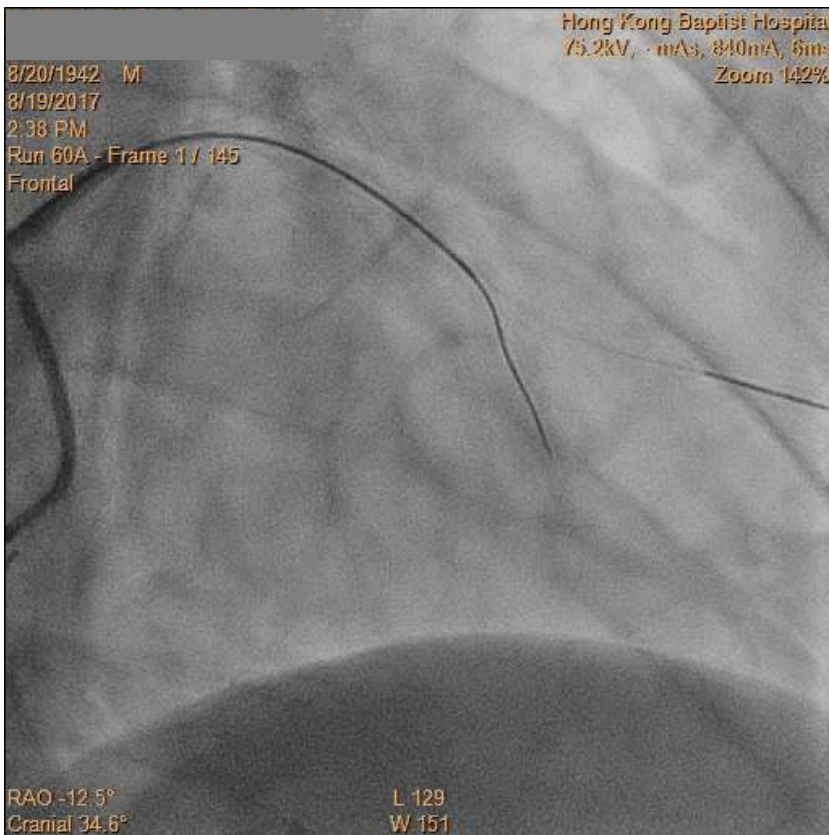


# PCI to LAD: Attempt to entry dLAD by Caravel and Gaia 3<sup>rd</sup> – some progress



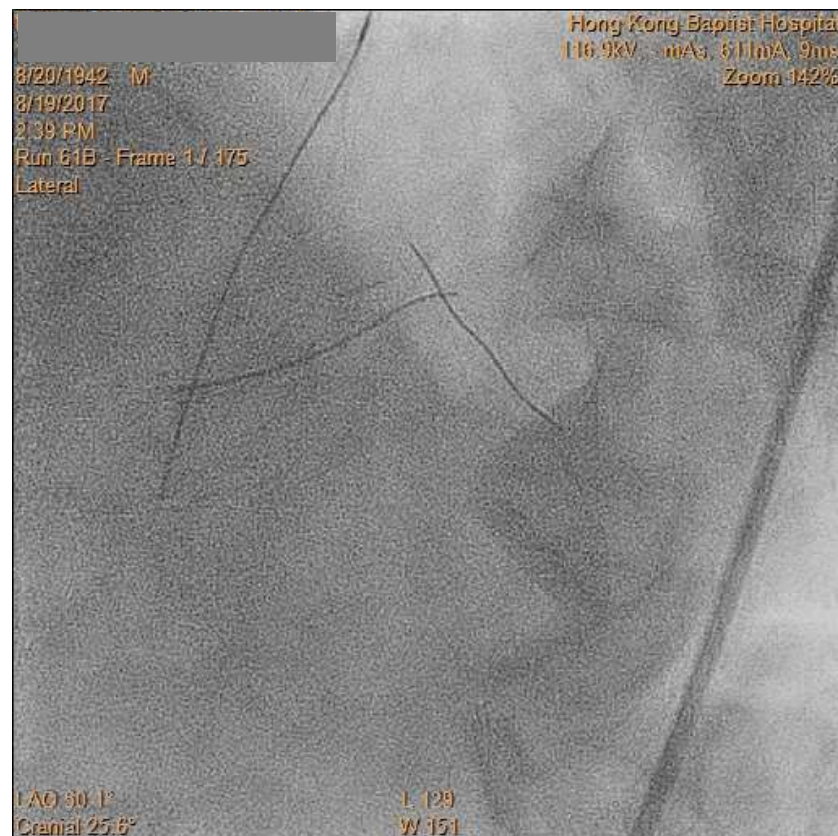
# PCI to LAD: Attempt to entry dLAD by Caravel and Gaia 3<sup>rd</sup> – crossed CTO

Gaia 3<sup>rd</sup> rotating inside true lumen



# PCI to LAD: Gaia 3<sup>rd</sup> crossed dLAD CTO

## Gaia 3<sup>rd</sup> inside true lumen of very distal LAD



# Procedure Not close to the end!

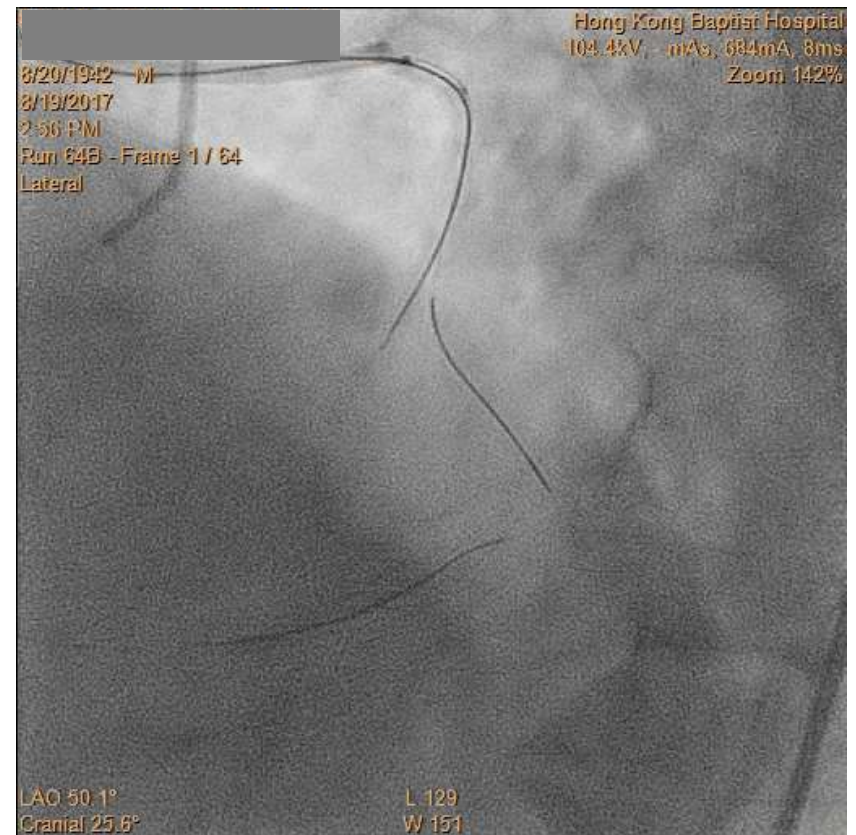
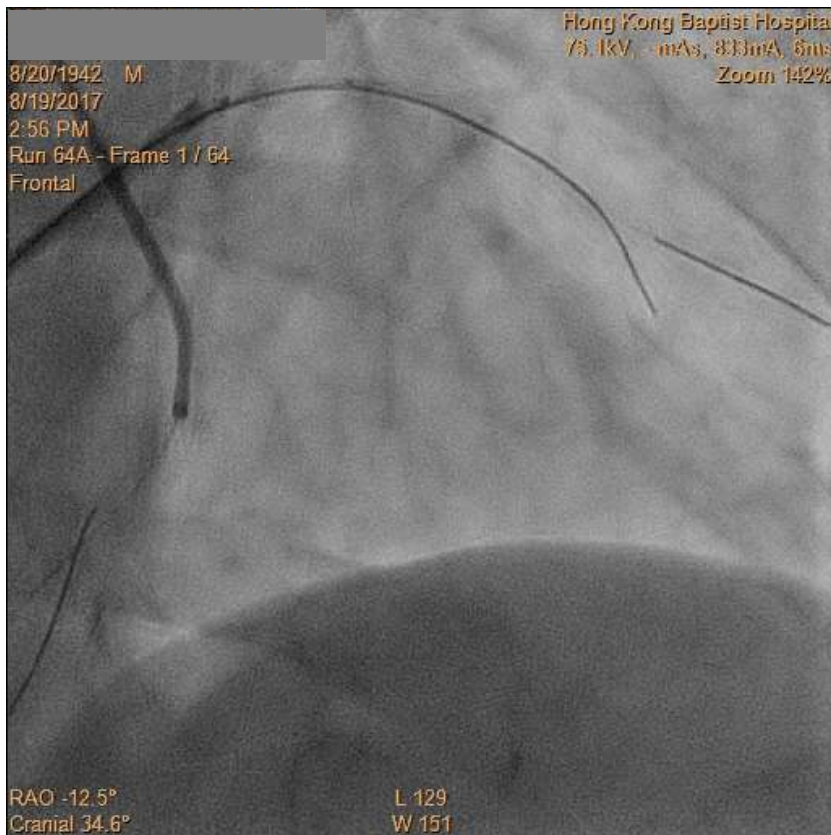
## Attempted to track Caravel to dLAD

- Caravel stuck at the dLAD CTO region & failed to proceed further during extensive maneuvering
- Attempt to remove Caravel & change MC, but Caravel shaft moving out with minimal movement of its opaque tip!

Trapping balloon at mLAD, but Caravel radiopaque tip still failed to retract!

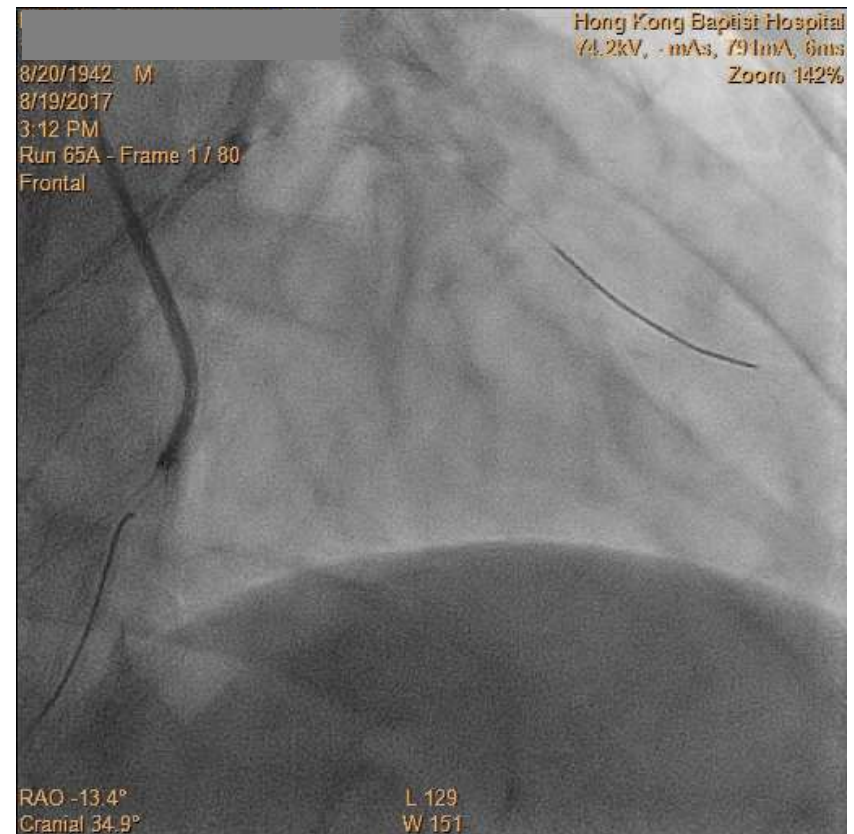


# Opaque tip of Caravel stuck with Gaia 3<sup>rd</sup>



# Gaia 3<sup>rd</sup> removed – Cavael tip fractured

- Opaque junction of Caravel tip was retrieved with Gaia 3<sup>rd</sup> after secured by Amplatz gooseneck snare
- Found Caravel tip fractured (during maneuvering), & stuck with Gaia 3<sup>rd</sup>
- Rest of Caravel was intact
- Angiogram: no vessel damage
- But need to start again!

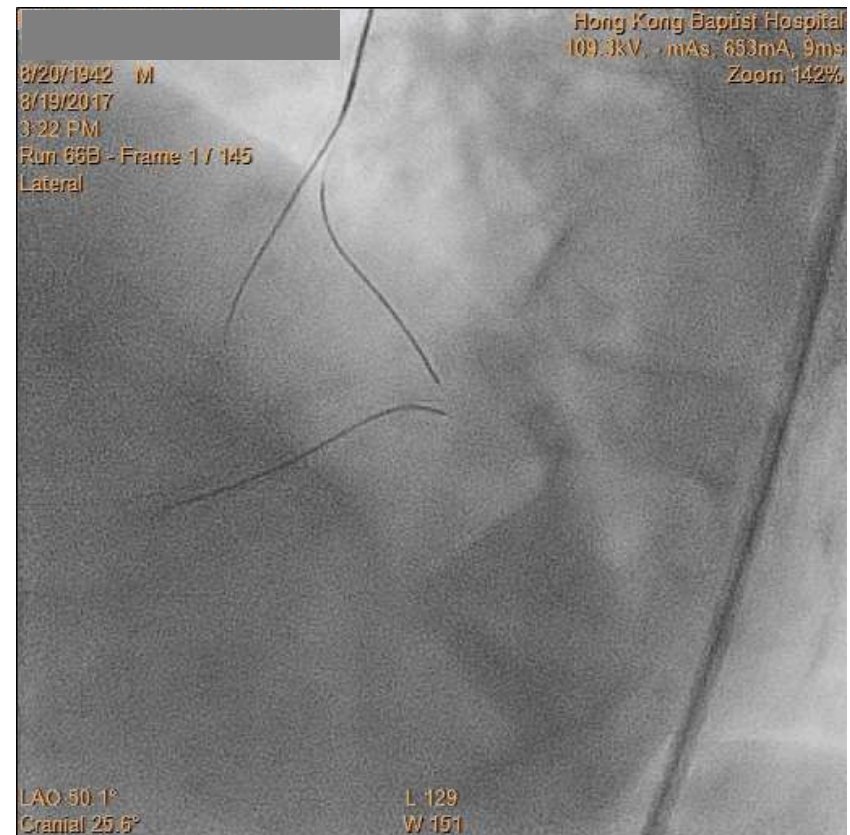


# Restart dLAD CTO crossing: Corsair with new Gaia 3<sup>rd</sup>

Tip of Gaia 3<sup>rd</sup> in subintimal tract

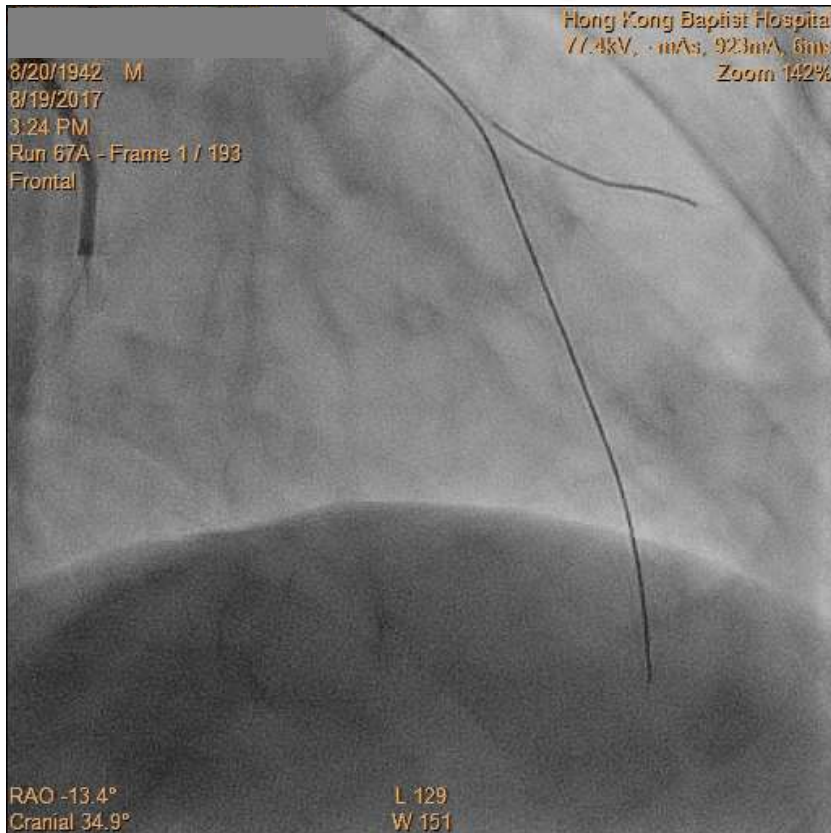


GW retracted & adjusted direction

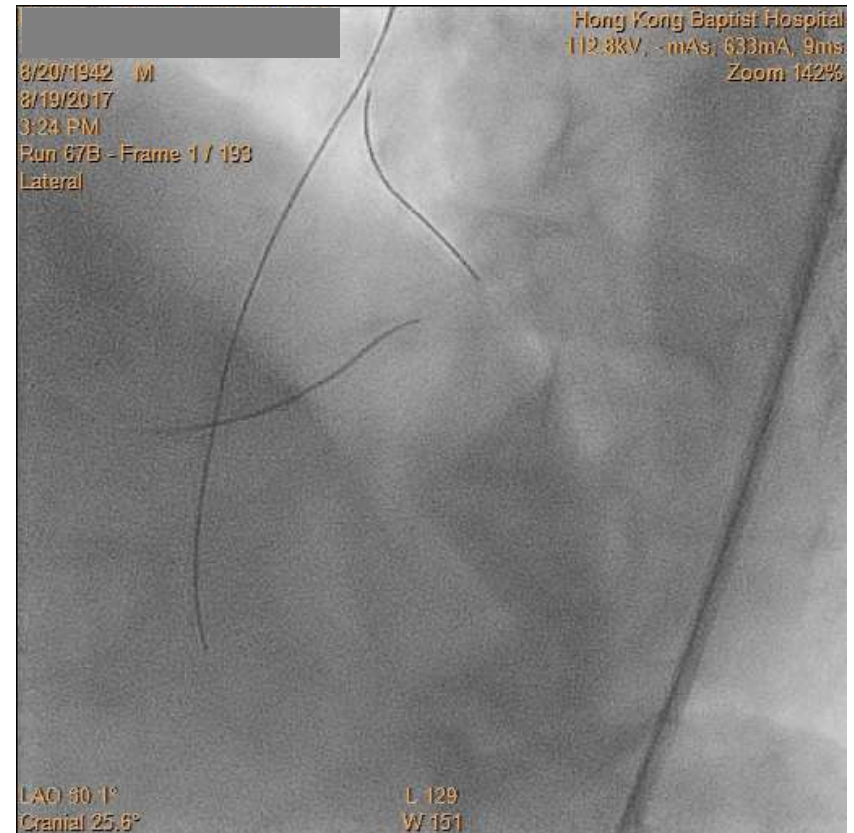


# Restart dLAD CTO crossing: Corsair with Gaia 3<sup>rd</sup> – some progress

Tip of Gaia 3<sup>rd</sup> in subintimal tract again



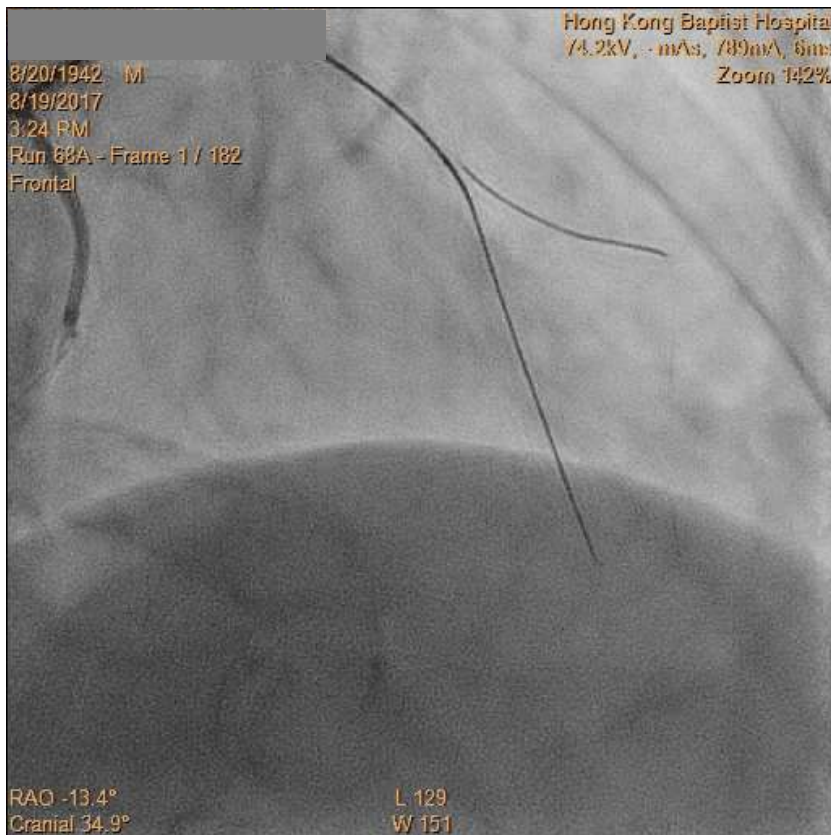
GW retracted & adjusted direction



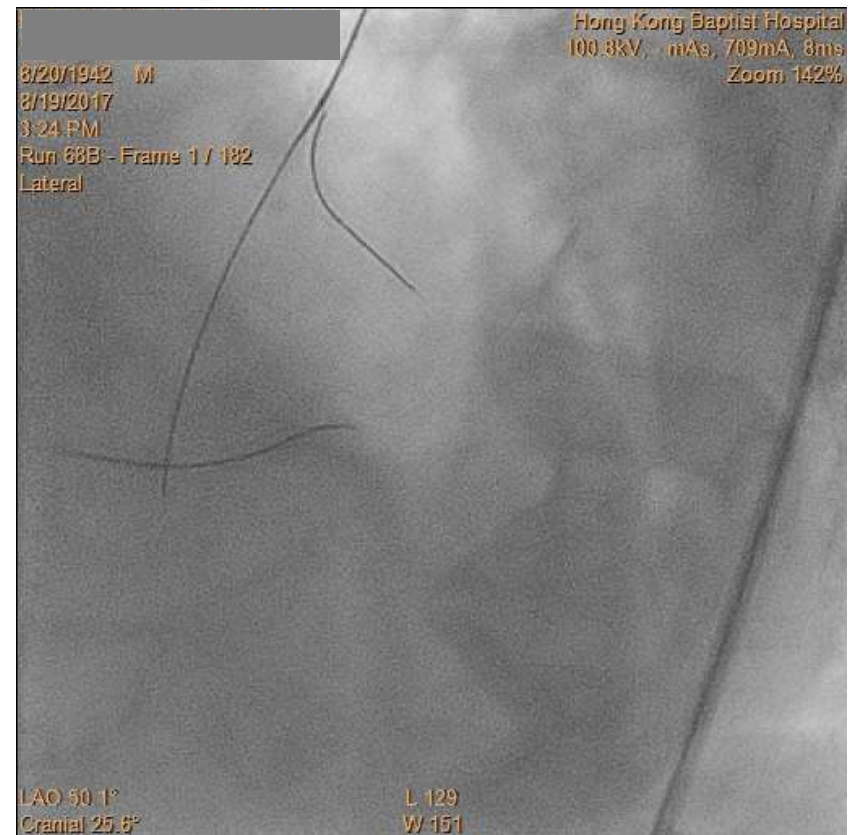


# Restart dLAD CTO crossing: Gaia 3<sup>rd</sup> reach true lumen of dLAD

**Gaia 3<sup>rd</sup> in true luminal course**

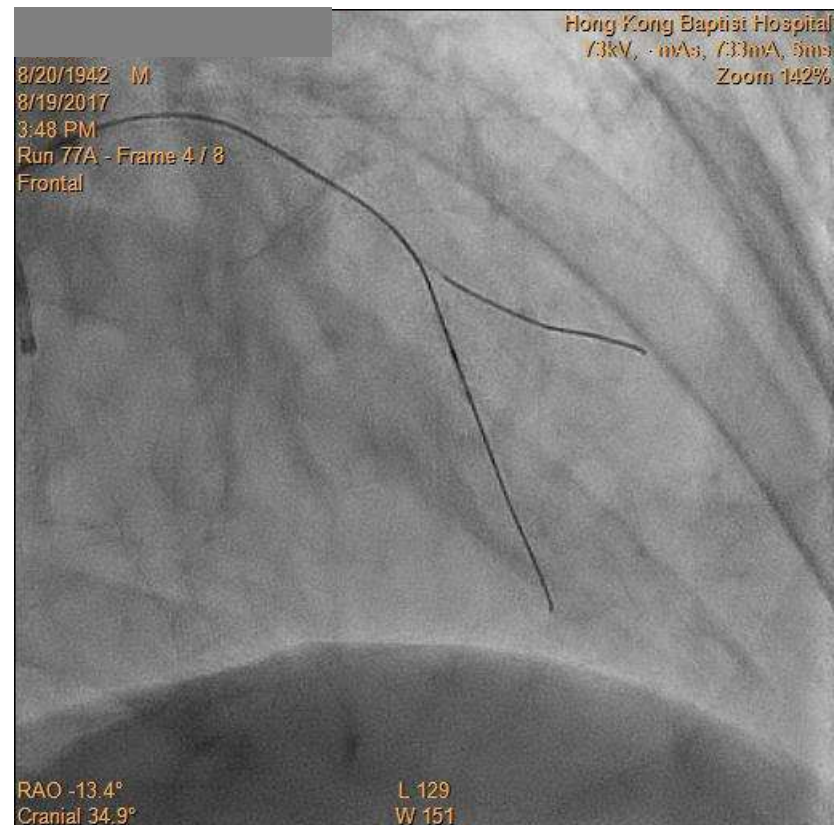


**GW tip if free to rotate**



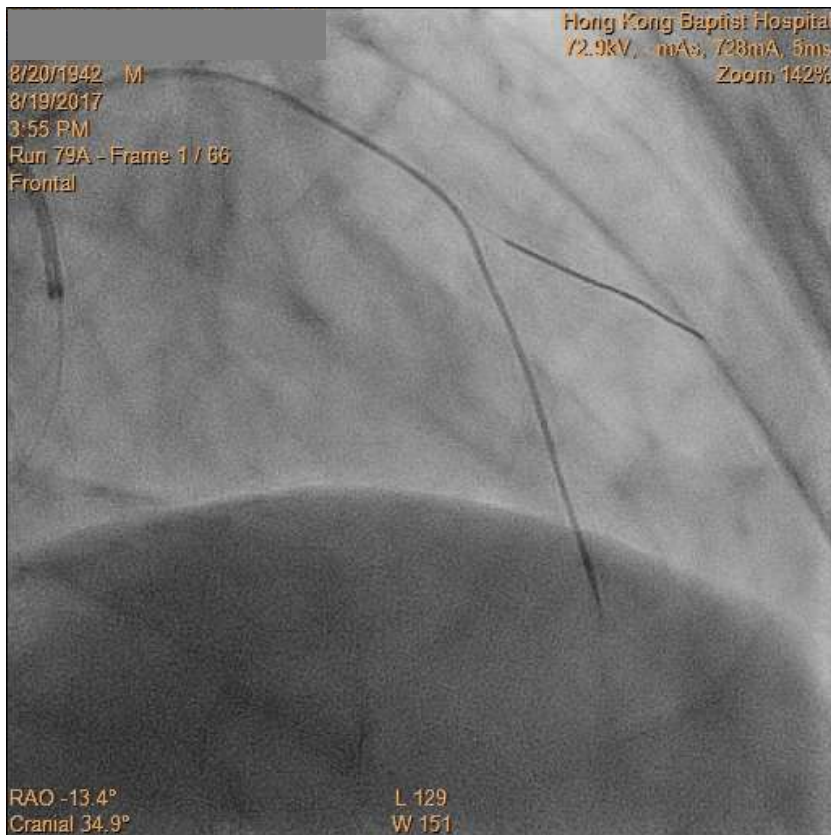
# Corsair failed to advance through the dLAD CTO!

- Corsair removed by trapping balloon at D1 wire
- POBA to dLAD by 1.25x10mm balloon at 10 atm → balloon ruptured!
- Another 1.25mm balloon with POBA @ 8-10atm
- Corsair able to cross CTO
- Exchanged to Runthrough NS Hypercoat GW

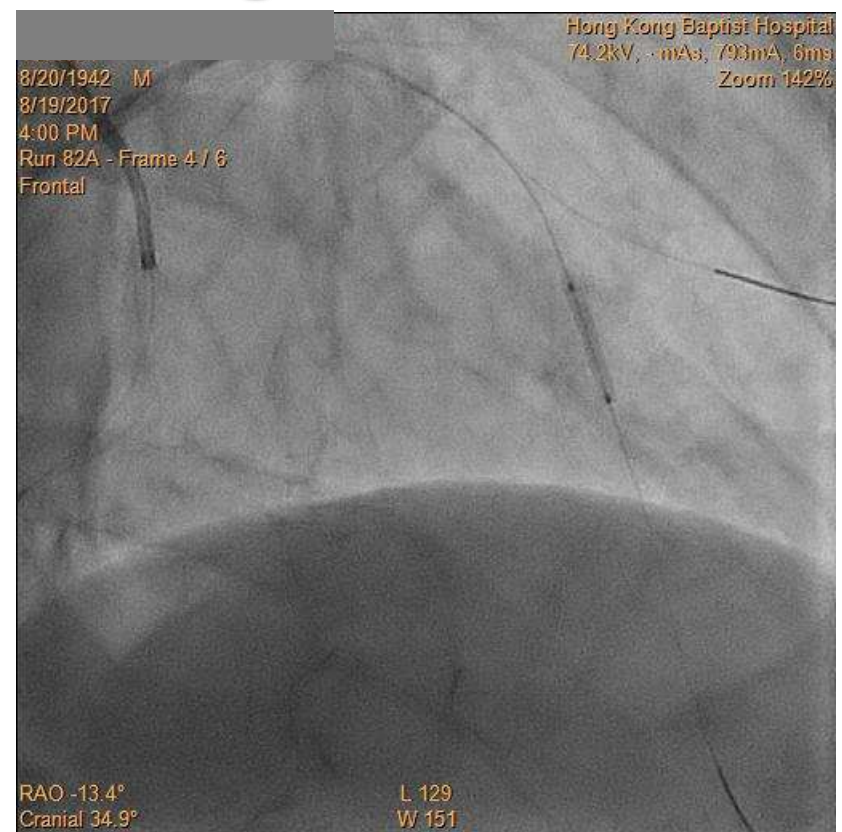


# Corsair advance through dLAD CTO, & POBA to m-dLAD

**Corsair injection:  
confirmed true lumen**

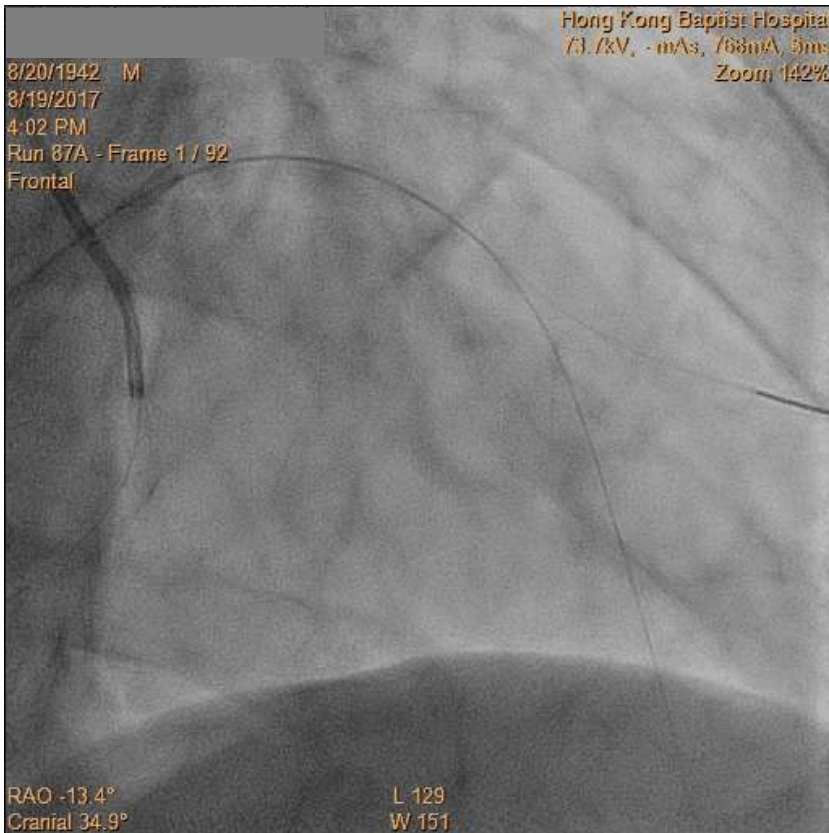


**POBA to m-dLAD by 2.0x15mm  
balloon @ 6-10 atm**

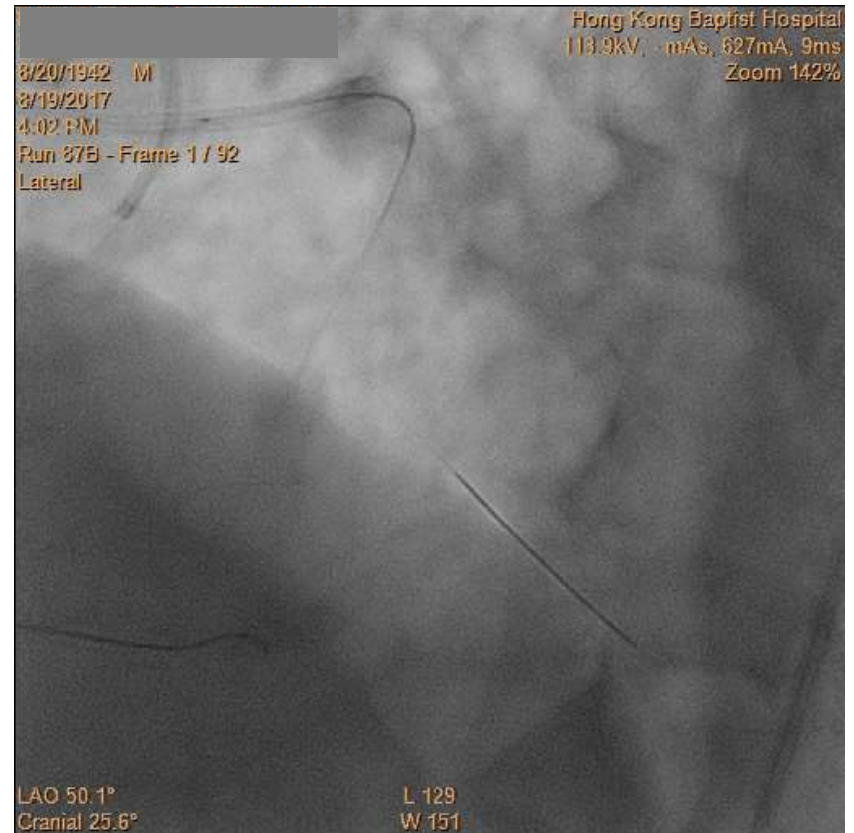


# Post-POBA angiogram

## AP Cranial

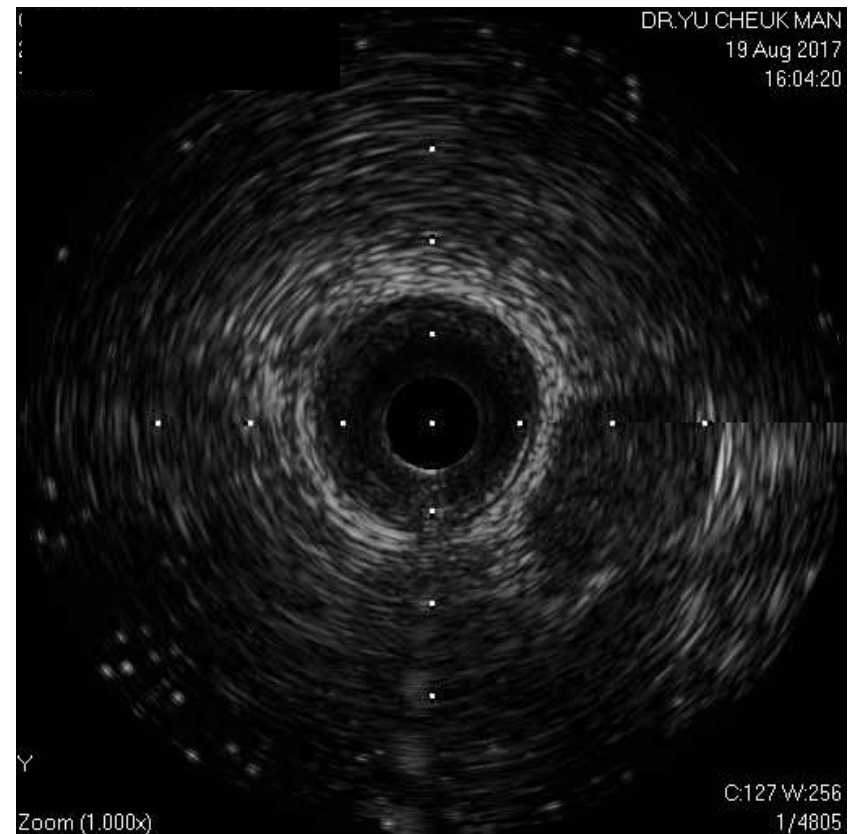


## LAO cranial

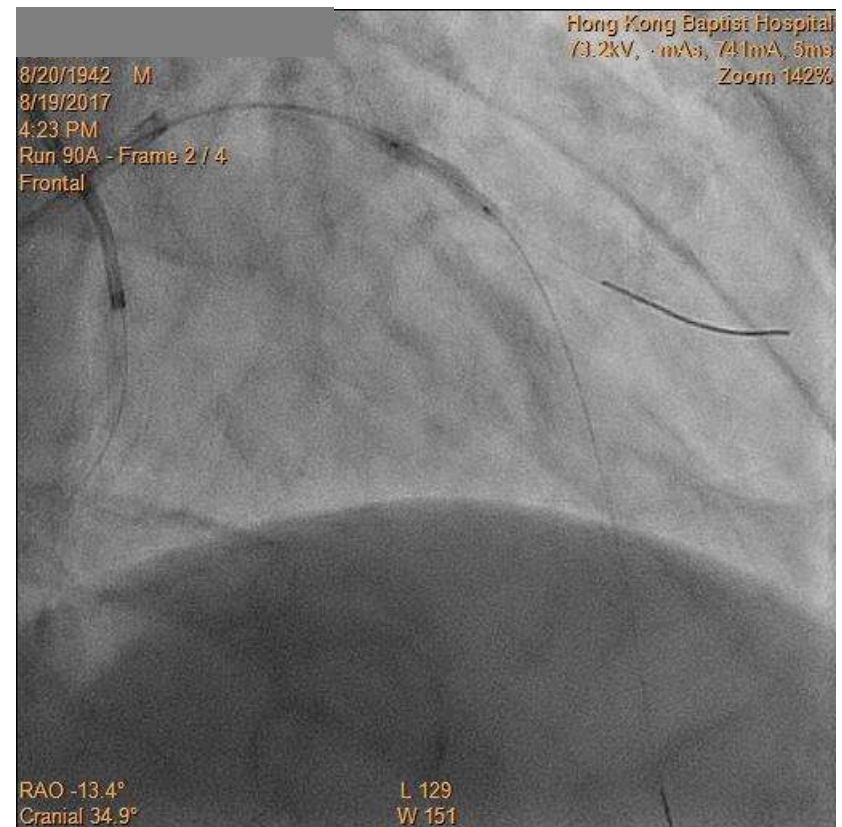
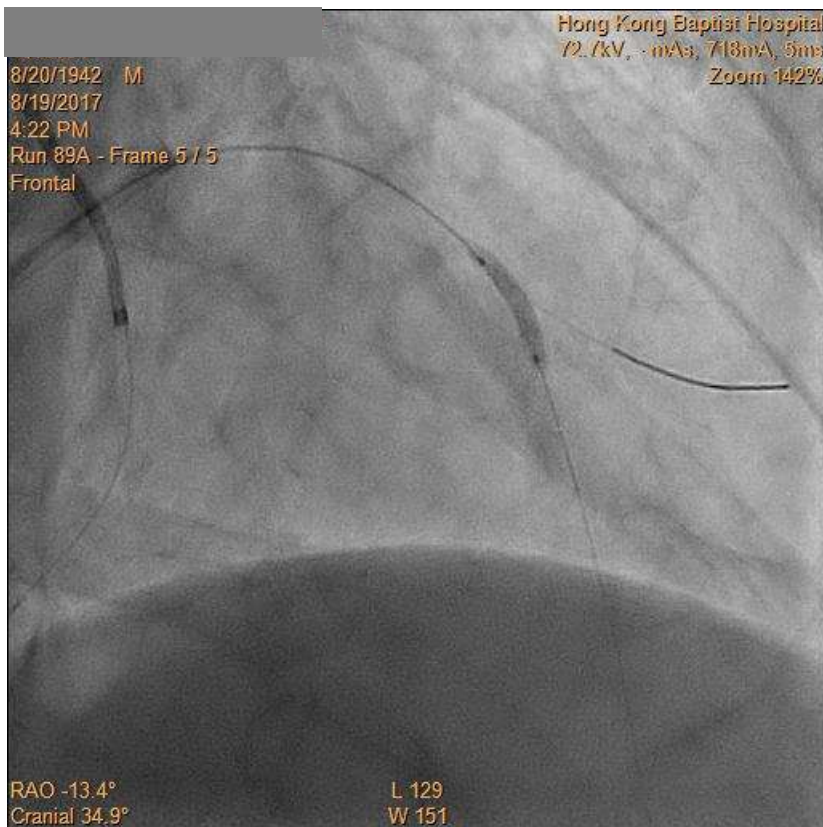


# IVUS to LAD

- Whole GW course at true lumen (for both CTO)
- Significant plaque burden in from proximal to distal LAD
- Guide sizing of stents

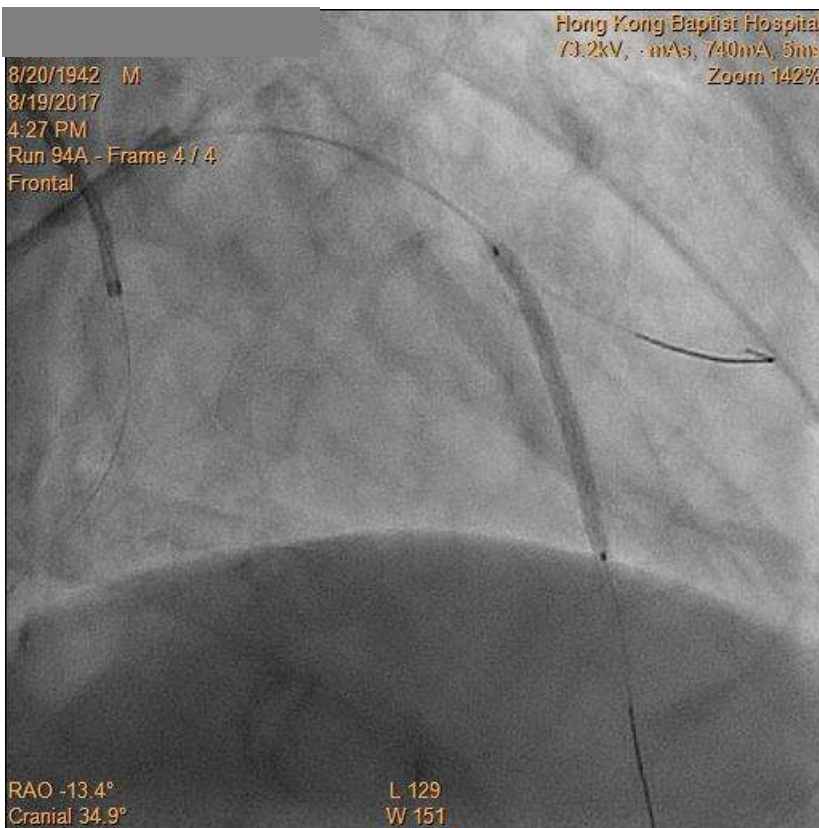


# Further POBA to p-m-dLAD: by 2.5 x 15mm balloon @ 6-10 atm

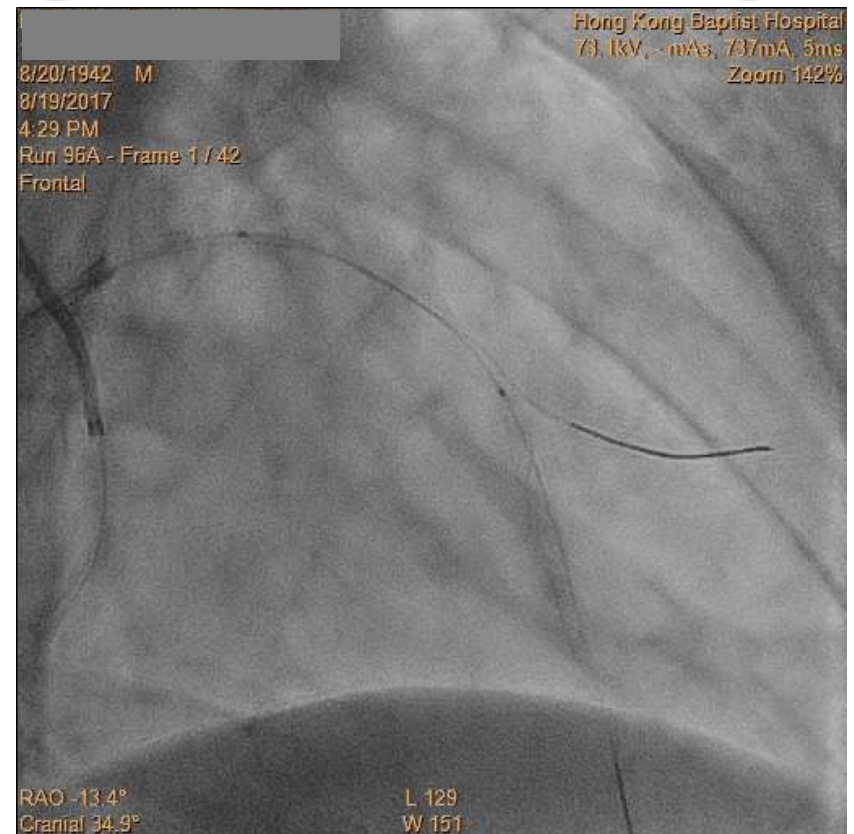


# Stenting to dLAD

**By BioFreedom 2.5x36mm  
at 8 atm**

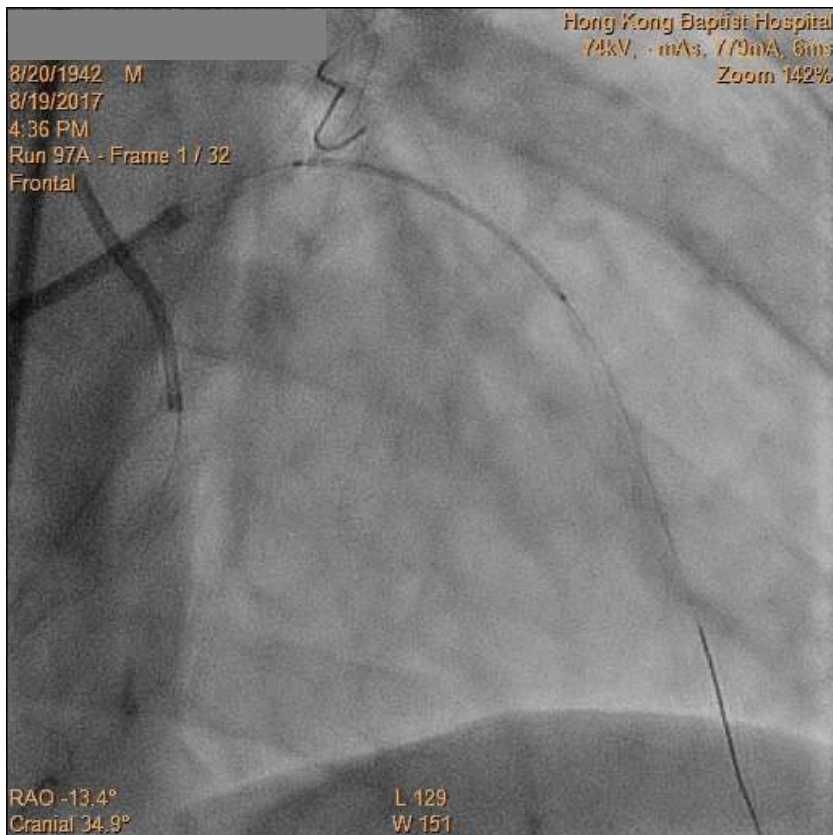


**Stent balloon POBA p-mLAD  
@12 atm, and measured length**

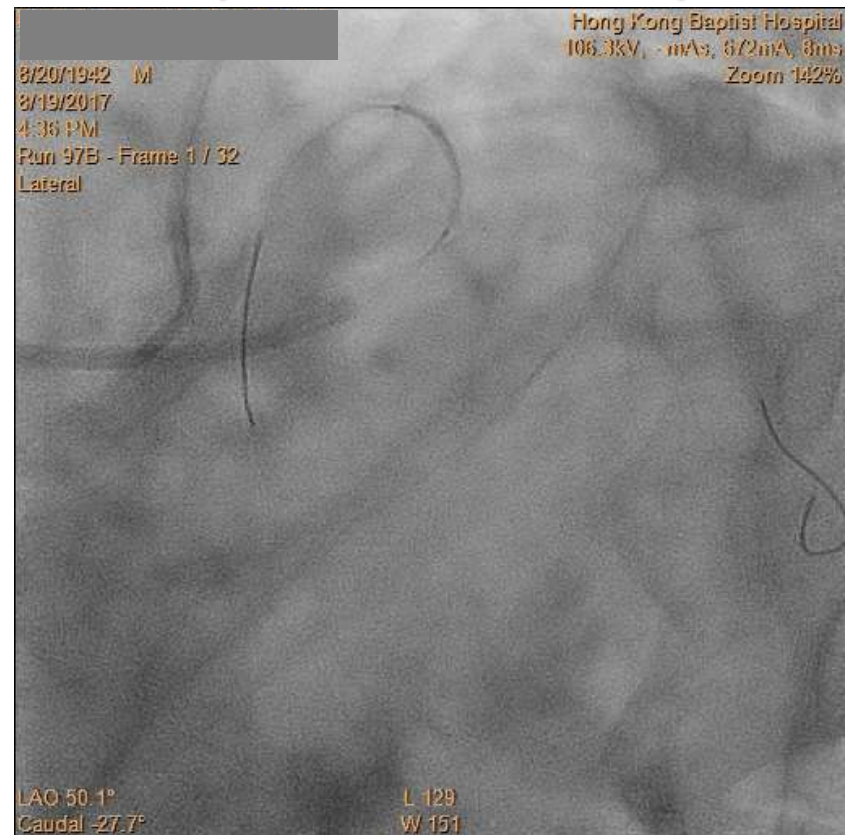


# Stenting to dLMS to p-mLAD

**By BioFreedom 3.5x36mm  
at 8 atm**



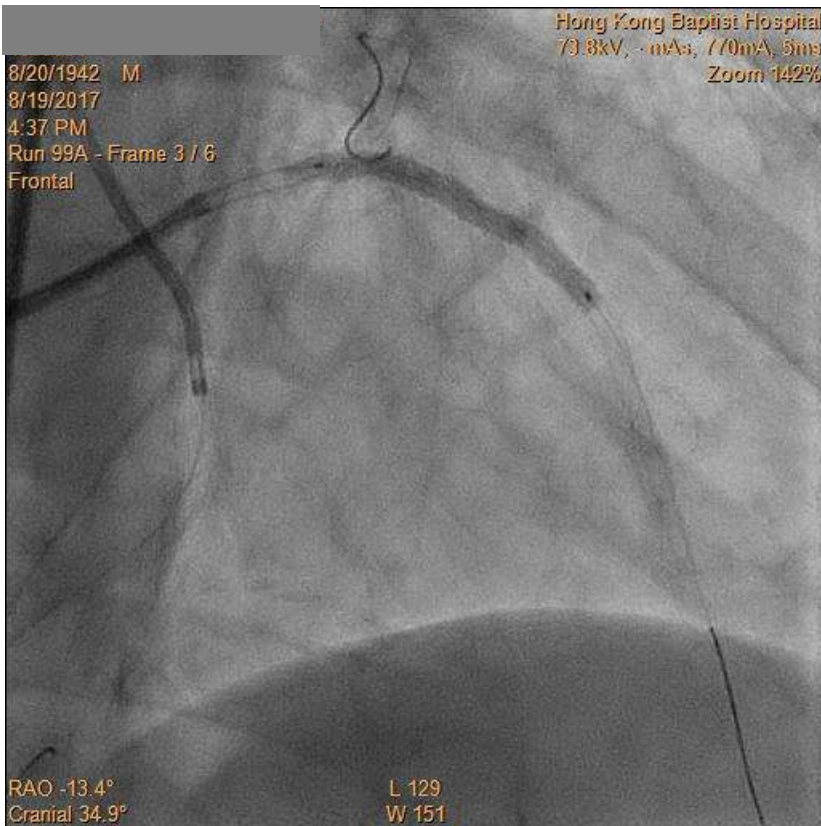
**Stent balloon further dilated at  
12 atm (inward & outward)**



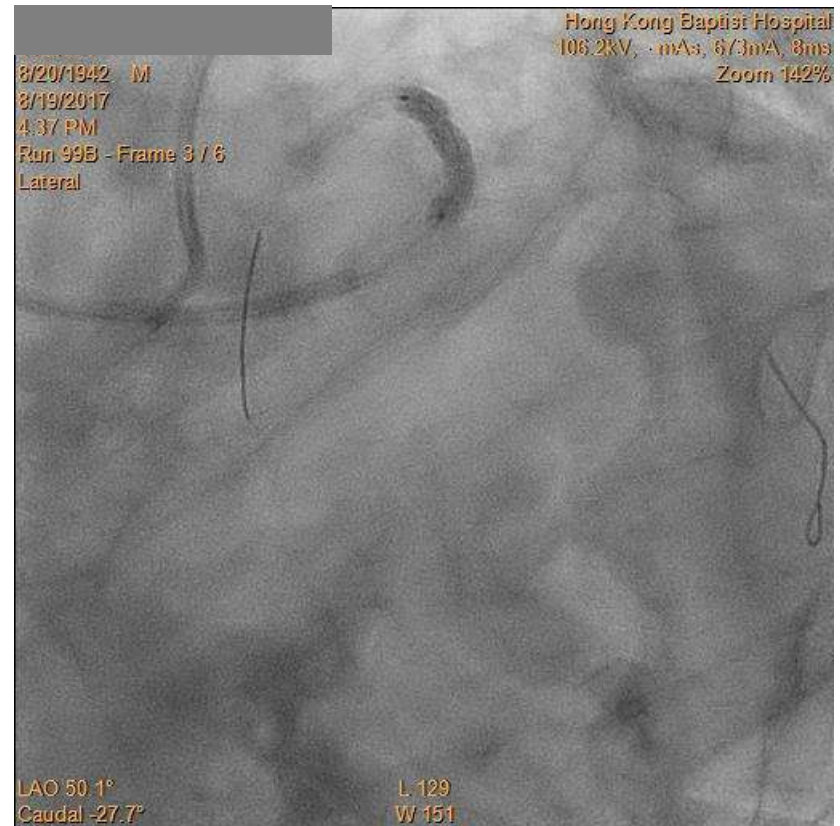


# Stenting to dLMS to p-mLAD

**By BioFreedom 3.5x36mm  
at 8 atm**

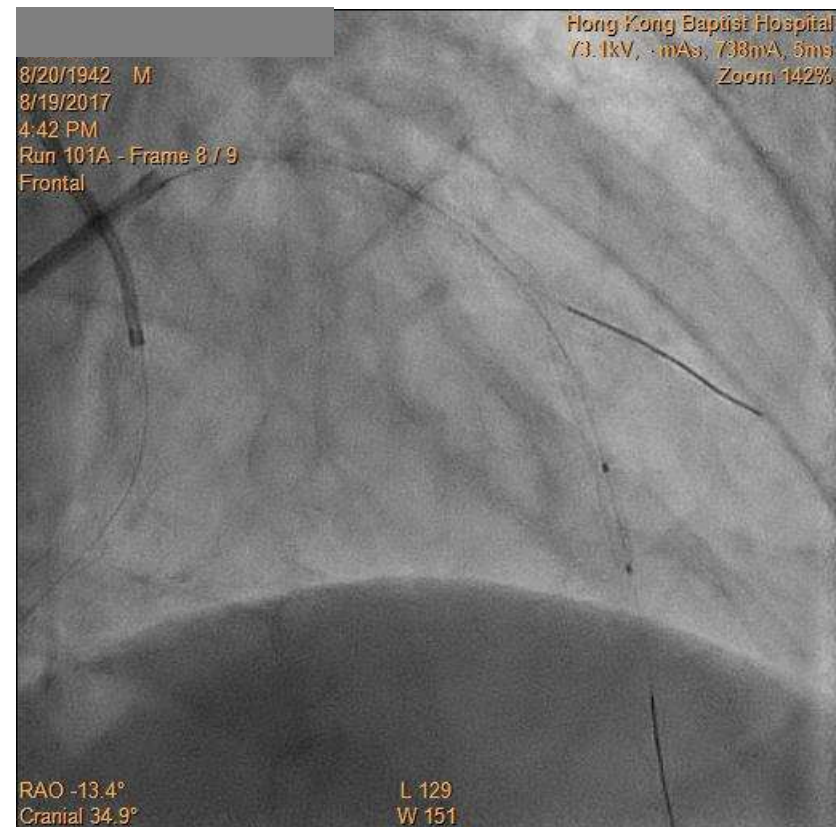


**Stent balloon further dilated at  
12 atm (inward & outward)**



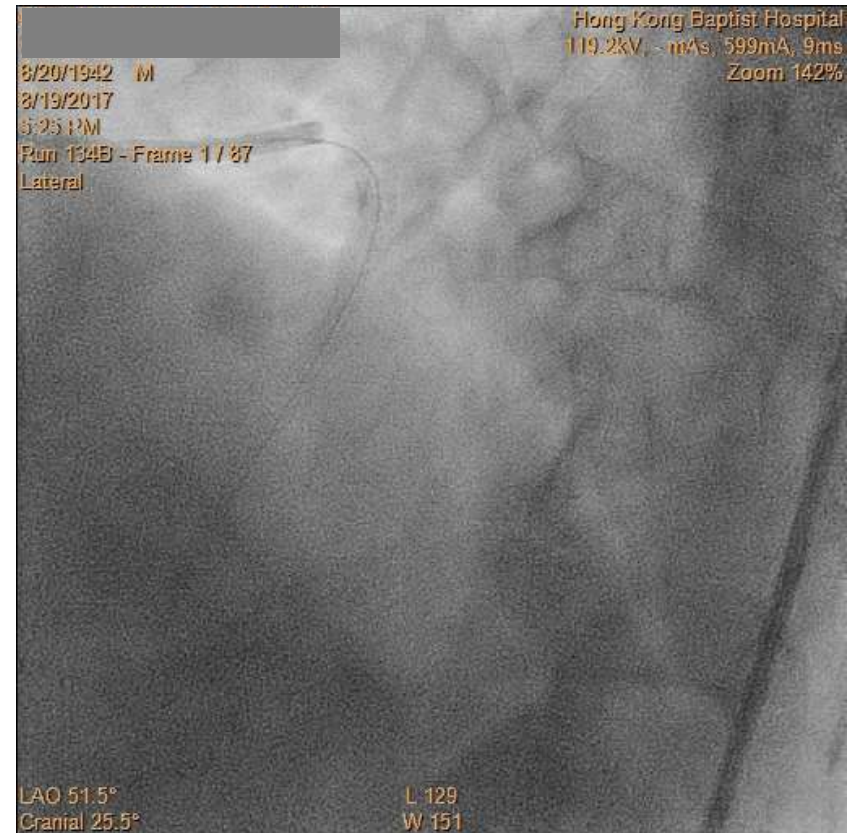
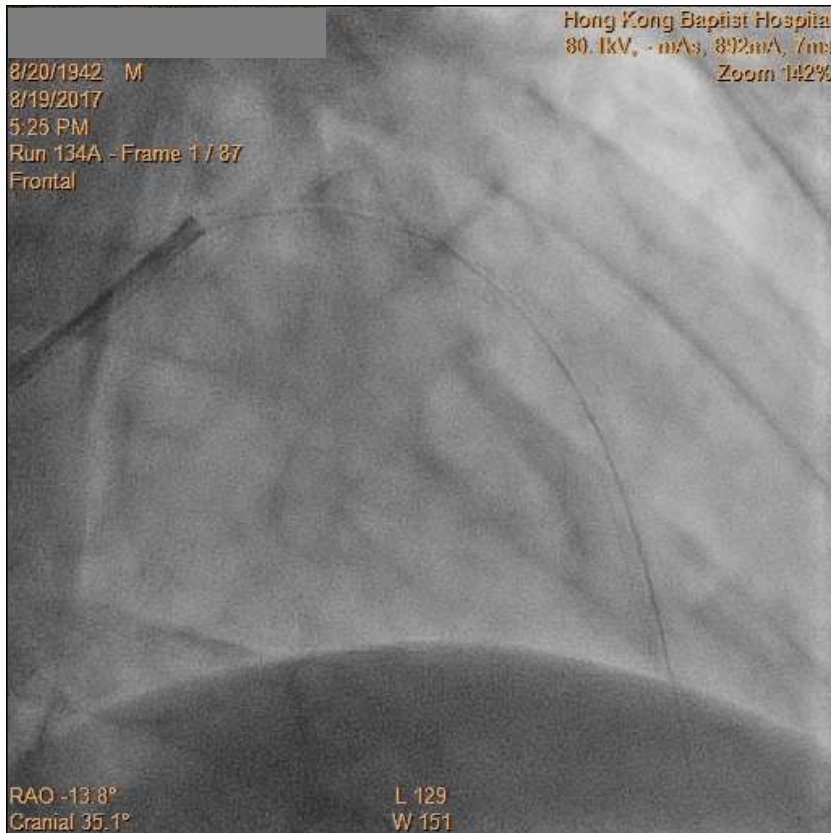
# IVUS guided Post-Dilatation of LAD Instant Segments

- 2.5x13mm NC up to 18 atm at m-dLAD, then
- 3.5x15mm NC up to 18 atm at p-mLAD, then
- 4.5x8mm NC at 12 atm at dLMS
- Also further POBA by 3.0x13mm NC balloon up to 18atm to p-mLAD



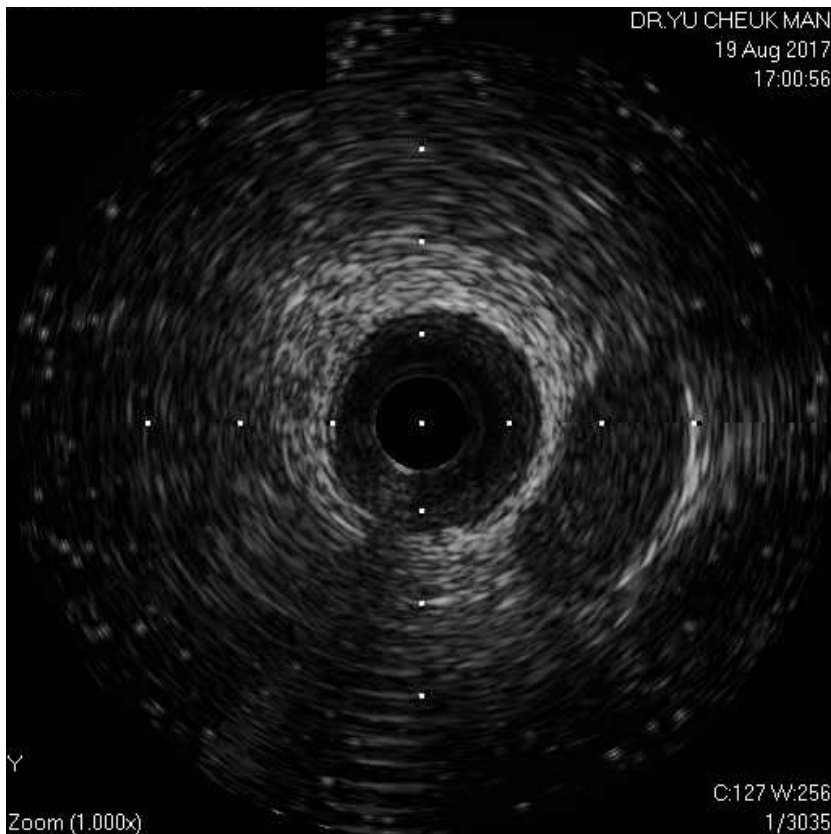
# Final Angiogram

## TIMI 3 flow



# Final IVUS

**Excellent stent expansion  
apposition, and no subintimal  
tract**



- Echo at CCL: No pericardial effusion
- R femoral artery closed by 8F Angioseal
- BP & pulse stable during PCI, and no CHF or angina symptoms
- Transferred to HD at ICU





# Progress Post-PCI

- HD on 19- & 21-8-2017 in ICU
- Creatinine peaked at  $461\mu\text{mol/L}$  on 22-8-2017
- Had UTI (Foley) and treated by antibiotics
- Creatinine started to drop on 23-8-2017
- Remain stable & out of HF symptoms
- Creatinine about  $200+\mu\text{mol/L}$  at discharge on 30-8-2017
- Adjusted medications for DM & HF





# Follow up Progress

- No more HF symptoms & signs, and no angina
- Back to normal exercise capacity with some wt loss (central obese), and able to reduce dose of Insulin + OHA
- Creatinine dropped to  $170+\mu\text{mol/L}$  2 weeks later, and further dropped and maintained at  $150+\mu\text{mol/L}$  since end of Sept 2017 till now
- Less PVCs at ECG monitoring
- NT-proBNP improved to 400+
- Echo: LV less dilated, and EF improved gradually to 45%. MR reduced to mild, and filling pressure normalized (E/E'). Normalized PASP





# Case Presentation

- Current medications:
- Cartia 100mg daily, Plavix 75mg daily
- Entresto 100mg BD, Concor 1.25mg OM,
- Febuxostat 40mg daily, Colchicine 0.5mg daily
- Pantoloc 40mg daily, Lipitor 10mg daily
- Lantus 14U post-B'fast, Victoza 1.8mg N SC, Jardiance 12.5mg OM
- Others: Harnal 0.4mg N, Vannair, Spiriva





# Take Home Message

- HF with recent onset of symptoms, underline multiple CV risk factors and CKD
- Poor risk candidate x CABG
- Coronary angiogram showed multiple CTO, but seems only antegrade approach feasible
- Well planned treatment strategy with multidisciplinary approach
  - Medical, PCI, Dialysis
  - Cardiologist, renal physicians, intensivist





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**THANK YOU**

