Side Branch Protection Techniques- New and Old

; focus on bifurcation PCI with 1-stent technique

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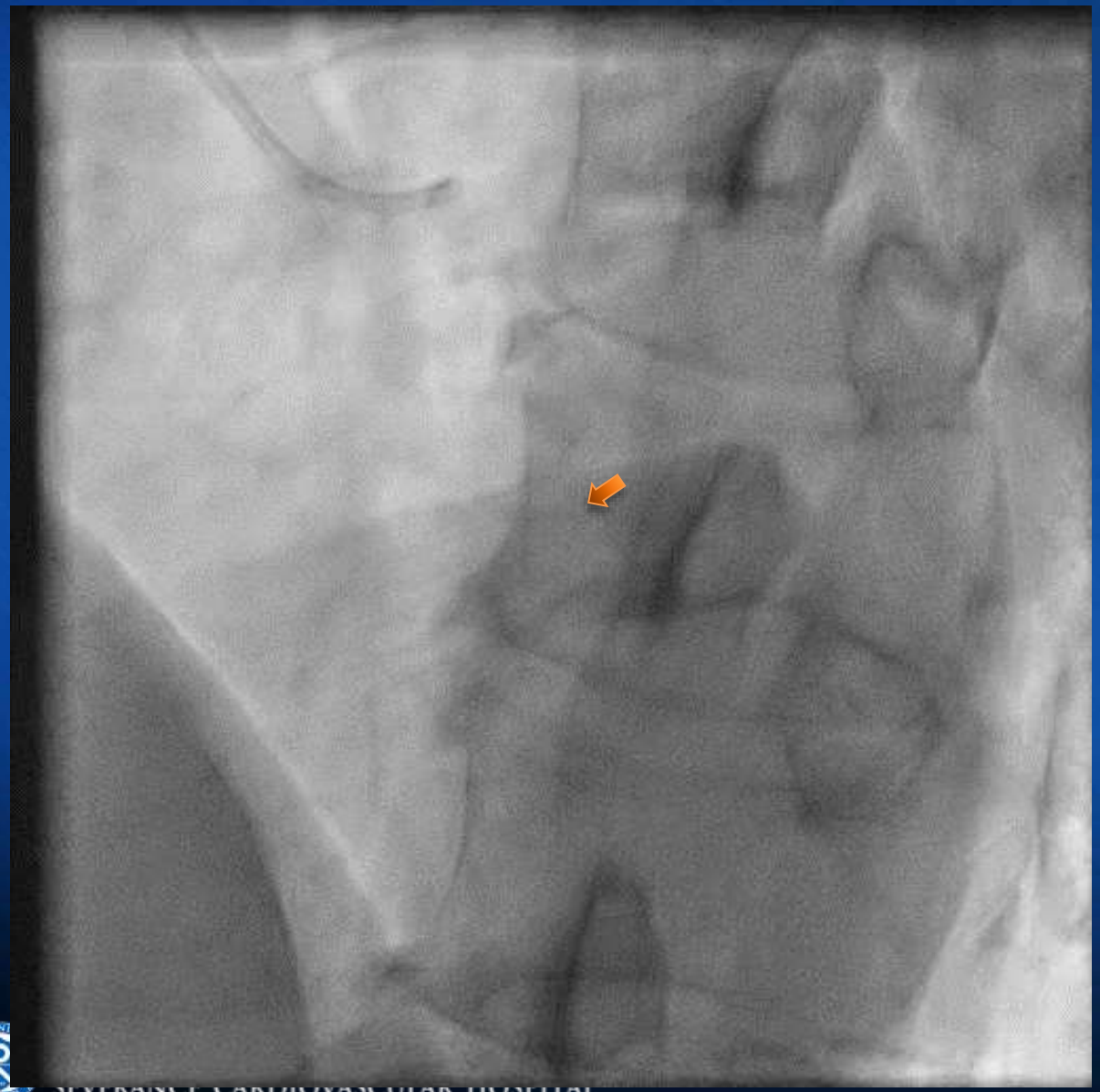
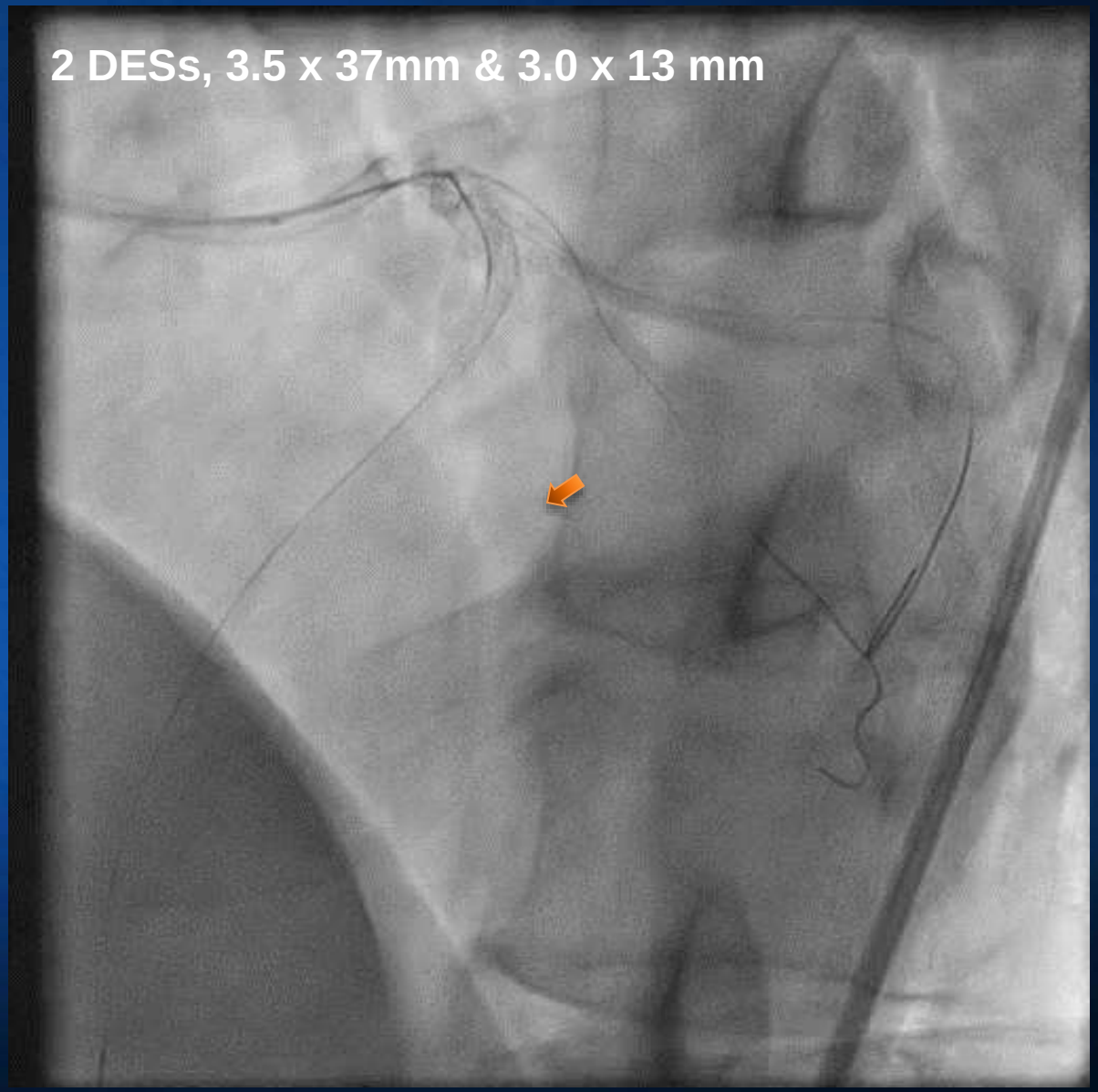
Disclosure

- Nothing to disclose, related with this lecture

Case

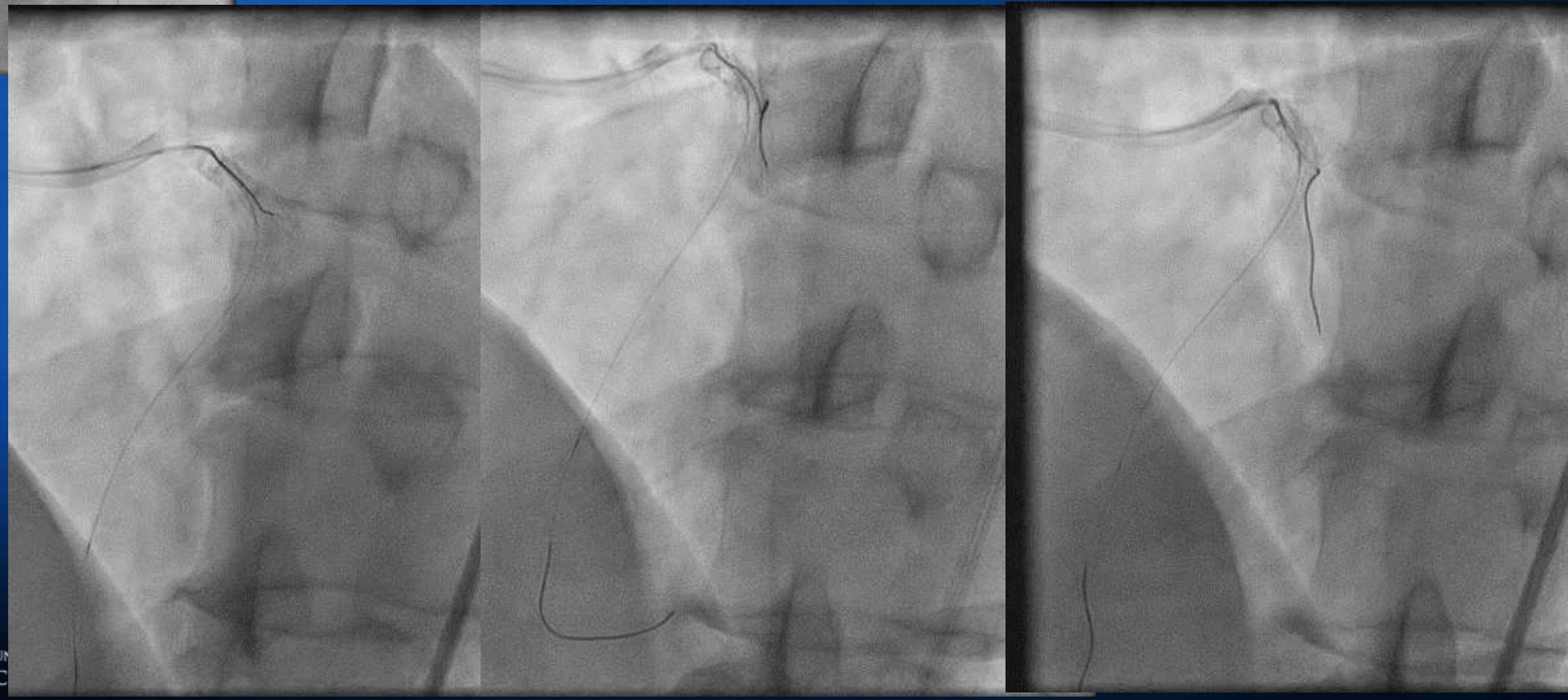
Diffuse long LAD diseases with stenosis of big diagonal branch





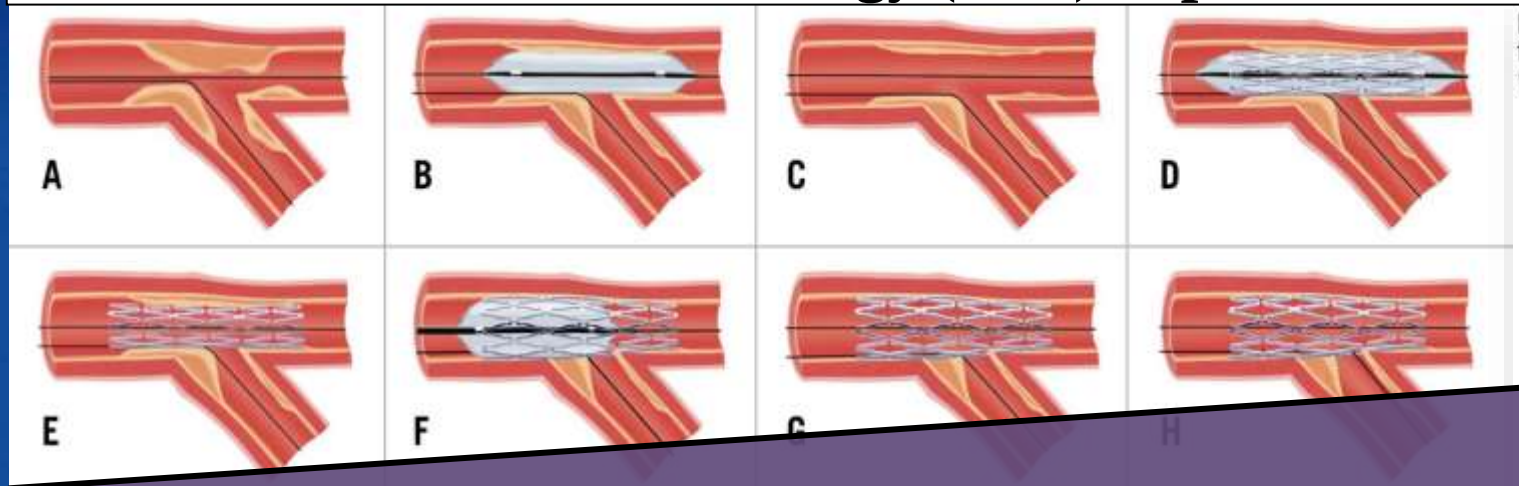
After stenting

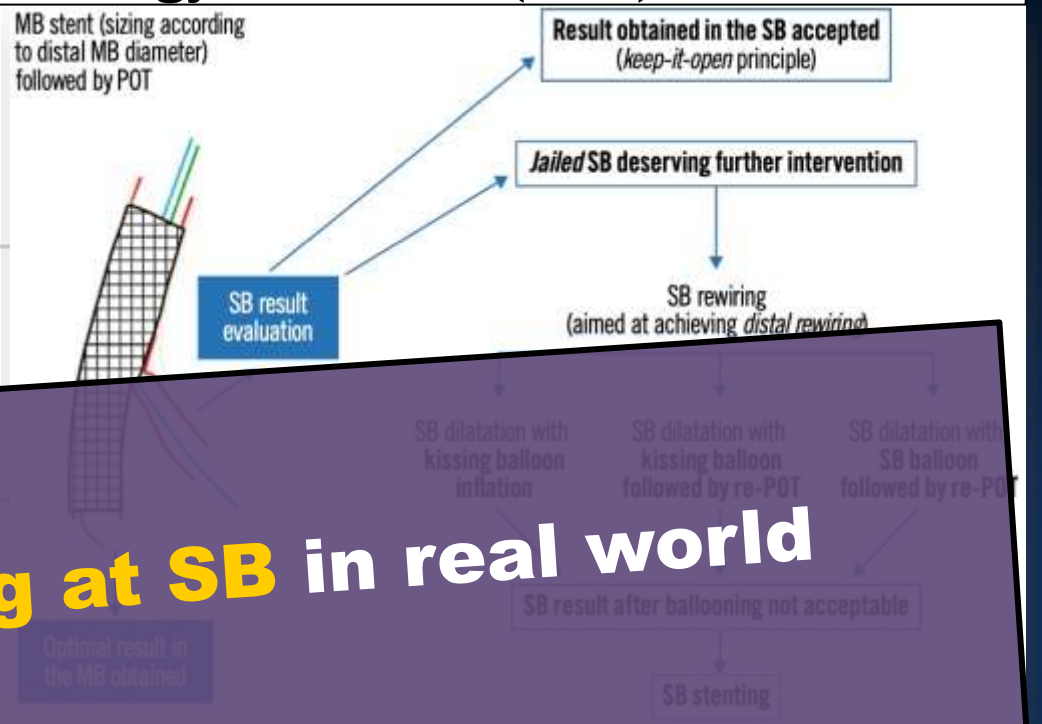
Wiring for jailed SB … but finally failed.



Bifurcation PCI with 1-stent technique on 2022 EBC guideline

Provisional strategy (A-G) & provisional strategy with KBI (A-L)





Unsolved issues;

- **Major determinants for wire-jailing at SB in real world practice?**
- **Wire jailing to SB could prevent SB occlusion in bifurcation with 1-stent ?**
- **For bifurcation PCI, wire-jailing always needed?**

Wire jailing to SB is essential in the provisional strategy, especially for bifurcation PCI with 1-stent technique (pre-stent & post-)

Hildick-Smith D et al. Eurointervention 2022

Predictors of SB occlusion after main vessel stenting?

- COBIS II registry data regrading the 1-stent technique or MV stenting first strategy (N=2,227).
  - PCI using DESs for bifurcation lesions with SB ≥2.3 mm were enrolled.; Definition of SB occlusion; TIMI flow grade <3 after MV stenting

→ Occurrence of SB occlusion; **8.4%** (187 of 2,227 bifurcation lesions)

- Independent Predictors of SB occlusion ; Angiographic findings of SB, proximal MV stenosis, and clinical presentation are predictive of SB occlusion after MV stenting.

▪ Impact of wire-jailing @ SB for SB protection?

Table 2 Lesion and Procedural Characteristics

Characteristic	SB Occlusion (n = 187)	No SB Occlusion (n = 2,040)	p Value
Jailed wire in the SB	123 (65.8)	1,237 (60.6)	0.17

No significant difference of SB occlusion whether to jail the wire @ SB or not.

→ ***No protective effect by wire-jailing ?***

Left main lesions (vs. non-left main lesions)	0.34 (0.16–0.72)	0.005

Hahn et al. J Am Coll Cardiol. 2013;62:1654-1659.

Effect of Wire Jailing at SB in 1-Stent Strategy for Coronary Bifurcation Lesions from COBIS III registry

Retrospective, multicenter, and observational registry of patients with CBL undergoing PCI with 2nd-generation DES; **MV ⌀ ≥ 2.5 mm and SB ⌀ ≥ 2.3 mm on QCA** were included.

Patients undergoing coronary bifurcation intervention with new-generation DES from COBIS III registry (N=2648)

Exclusion
- 499, **elective 2-stent technique**
- 244, **SB pre-dilation before main-vessel stenting**
- 15, **only significant stenosis at SB** without significant stenosis at main vessel (Medina 0.0.1)

A total of 1890 patients with bifurcation intervention using 1-stent technique were finally enrolled (n=1890)

Wire-jailing at SB (n=819)

Non-wire-jailing (n=1071)

- Primary endpoint: occurrence of **final SB occlusion (final SB TIMI flow <3)** after MV stenting

- Secondary endpoints:
  - **Target lesion failure** (**TLF**; cDeath, MI, and TLR)
  - **Angiographic success**; final TIMI-3 + RS <30% in MV and <50% in SB
  - **Procedural success**; Angiographic success + no cDeath, STEMI, or emergency CABG
  - Abrupt SB occlusion; TIMI-0 after SB occlusion
  - Restoration of SB flow; TIMI-3 after SB occlusion

- Angiographic and Procedural Characteristics

Characteristics	Wire-jailing (n=819)	Non-Wire-jailing (n=1071)	*P*-value
Bifurcation location			<0.001
Left main / LAD	**321 (39.2)** / 380 (46.4)	286 (27.6) / 486 (46.9)	
LCx / RCA	90 (11.0) / 28 (3.4)	177 (17.1) / 87 (8.4)	
Medina classification			<0.001
1.1.1	**279 (34.1)**	175 (16.9)	
1.0.1 / 0.1.1	47 (5.7) / 60 (7.3)	47 (4.5) / 62 (6.0)	
Bifurcation angle, °	72.2 ± 23.8	71.0 ± 21.2	0.232
Heavy calcification of SB	**59 (7.2)**	49 (4.7)	0.031
Thrombus containing at SB	**7 (0.9)**	1 (0.1)	0.025
Type of DESs			<0.001
Biolimus-eluting	156 (19.0)	236 (22.8)	
Everolimus-eluting	437 (53.3)	437 (42.2)	
Zotarolimus-eluting	201 (24.5)	301 (29.1)	
Use of IVUS	386 (47.1)	329 (31.8)	<0.001
MV stent diameter, mm	3.2 ± 0.6	3.1 ± 0.6	0.032
MV stent length, mm	28.0 ± 12.2	29.4 ± 14.8	0.030

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Choi YJ, Lee SJ, Kim BK, et al. J Am Coll Cardiol Intv 2022;15:443–55.

Major determinants for wire-jailing at SB

In what case is wire-jailing at SB done the most ?

Variables	Univariable analysis			Multivariable analysis		
	Unadjusted	95% CI	p value	Adjusted OR	95% CI	p value
Pre-procedural DS of SB ≥ 50%	1.71	1.41-2.08	<0.001	2.45	1.98-3.04	<0.001
Pre-procedural DS of MV ≥ 50%	1.85	1.53-2.25	<0.001	2.17	1.76-2.67	<0.001
Left main lesion	1.62	1.35-1.96	<0.001	1.69	1.38-2.06	<0.001

Choi YJ, Lee SJ, Kim BK, et al. J Am Coll Cardiol Intv 2022;15:443–55.

Angiographic and procedural outcomes

	Event Rate		Unadjusted		IPTW Adjusted	
	Wire-jailing (n=819)	**Non-Wire-jailing (n=1071)**	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Any abrupt SB occlusion	**29 (3.5%)**	**40 (3.7%)**	0.95(0.58-1.17)	0.824	0.68(0.35-1.32)	0.257
Restoration of SB flow	**14 (1.7%)**	**9 (0.8%)**	2.98(1.34-7.80)	0.026	2.74(1.14-7.24)	0.037
Final SB occlusion	**15 (1.8%)**	**31 (2.9%)**	0.63(0.34-1.17)	0.141	0.62(0.33-1.16)	0.133
Any abrupt SB occlusion	**29**	**40**				
- Restoration of SB flow	**14 (48%)**	**9 (22%)**				
- Final SB occlusion	**15 (52%)**	**31 (78%)**	0.66 (0.45 – 0.98)	**0.020**		

Choi YJ, Lee SJ, Kim BK, et al. J Am Coll Cardiol Intv 2022;15:443–55.

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Final SB occlusion	**15 (1.8%)**	**31 (2.9%)**	0.63(0.34-1.17)	0.141	0.62(0.33-1.16)	0.133
Final SB occlusion of lesions with any abrupt SB occlusion	**15 (52%)**	**31 (78%)**	0.66 (0.45 – 0.98)	**0.020**		
Angiographic success	520 (63.5%)	695 (64.9%)	0.94(0.78-1.14)	0.529	1.13(0.86-1.50)	0.374
Procedural success	518 (63.2%)	692 (64.6%)	0.94(0.78-1.14)	0.540	1.14(0.87-1.51)	0.372
In-hospital death or STEMI	2 (0.2%)	4 (0.4%)	0.65(0.12-3.57)	0.623	0.70(0.13-3.86)	0.683
Wire broken during procedures	0 (0.0%)	0 (0.0%)	-	-	-	-

Choi YJ, Lee SJ, Kim BK, et al. J Am Coll Cardiol Intv 2022;15:443–55.

Treatments of bifurcation after MV stenting

	Event Rate		Unadjusted		IPTW Adjusted	
	Wire-jailing (n=819)	Non-Wire-jailing (n=1071)	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Final kissing ballooning	214 (26.1%)	65 (6.1%)	5.47(4.07-7.36)	<0.001	5.25(3.52-7.83)	<0.001
Proximal optimization technique	304 (37.1%)	259 (24.2%)	1.88(1.53-2.29)	<0.001	1.50(1.22-1.86)	<0.001
SB ballooning without kissing balloon	39 (4.8%)	27 (2.5%)	1.87(1.43-3.08)	0.014	1.67(1.27-2.77)	0.024
SB ballooning after MV stenting	253 (30.9%)	92 (8.6%)	4.76(3.67-6.17)	<0.001	5.18(3.61-7.42)	<0.001
SB stent implantation	58 (6.8)	14 (1.3)	5.54(3.06-10.03)	<0.001	5.92(3.24-10.80)	<0.001
Noncompliant ballooning for MV	161 (19.7)	163 (15.2)	1.36(1.07-1.73)	0.028	1.46(1.03-2.05)	0.032

Choi YJ, Lee SJ, Kim BK, et al. J Am Coll Cardiol Intv 2022;15:443–55.

Protection of SB occlusion after main vessel stenting

Wire-jailing @ SB VS **Non-wire jailing**

Similar final SB occlusion rate … but, …

- Final kissing ballooning
- Proximal optimization technique
- SB ballooning or SB stenting
- Non-compliant ballooning for MV

more frequently occurred in the Wire-jailing group !

- **In case of 1-stent bifurcation PCI,**

wire-jailing @ SB always needed?

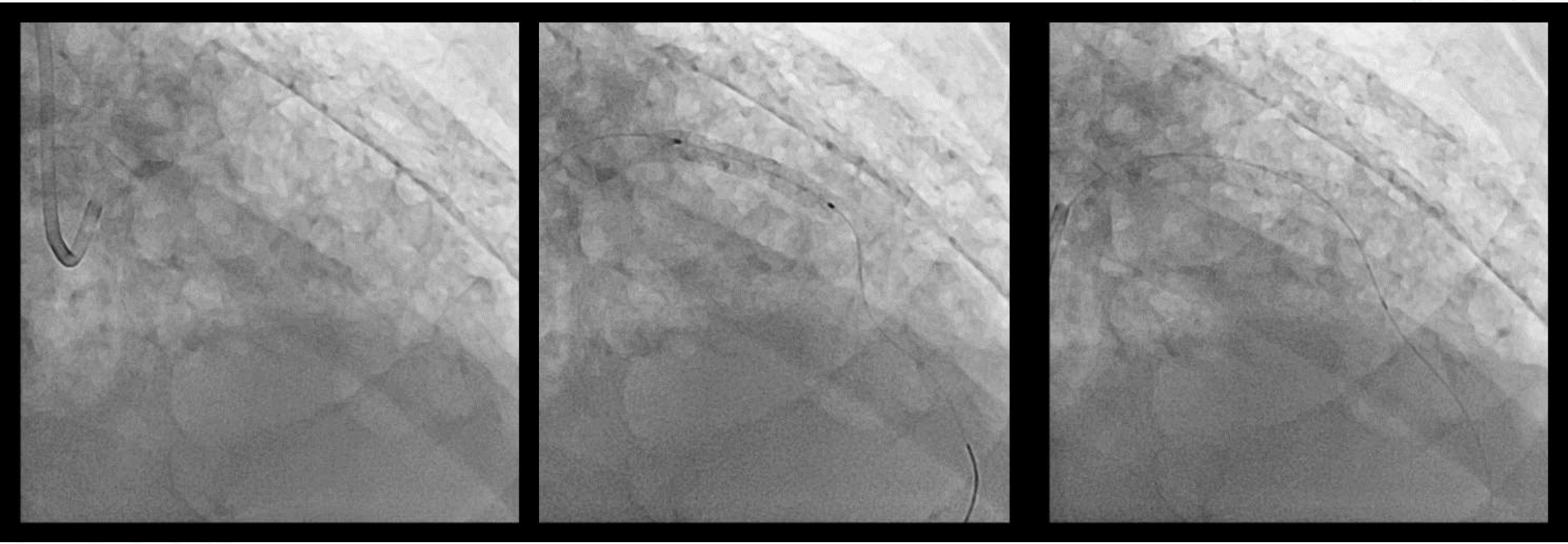
→ resulted in the ***lower rate of final SB occlusion after abrupt SB occlusion*** during procedures !

73 / M, Effort angina

- DM, HT, AF s/p RFCA

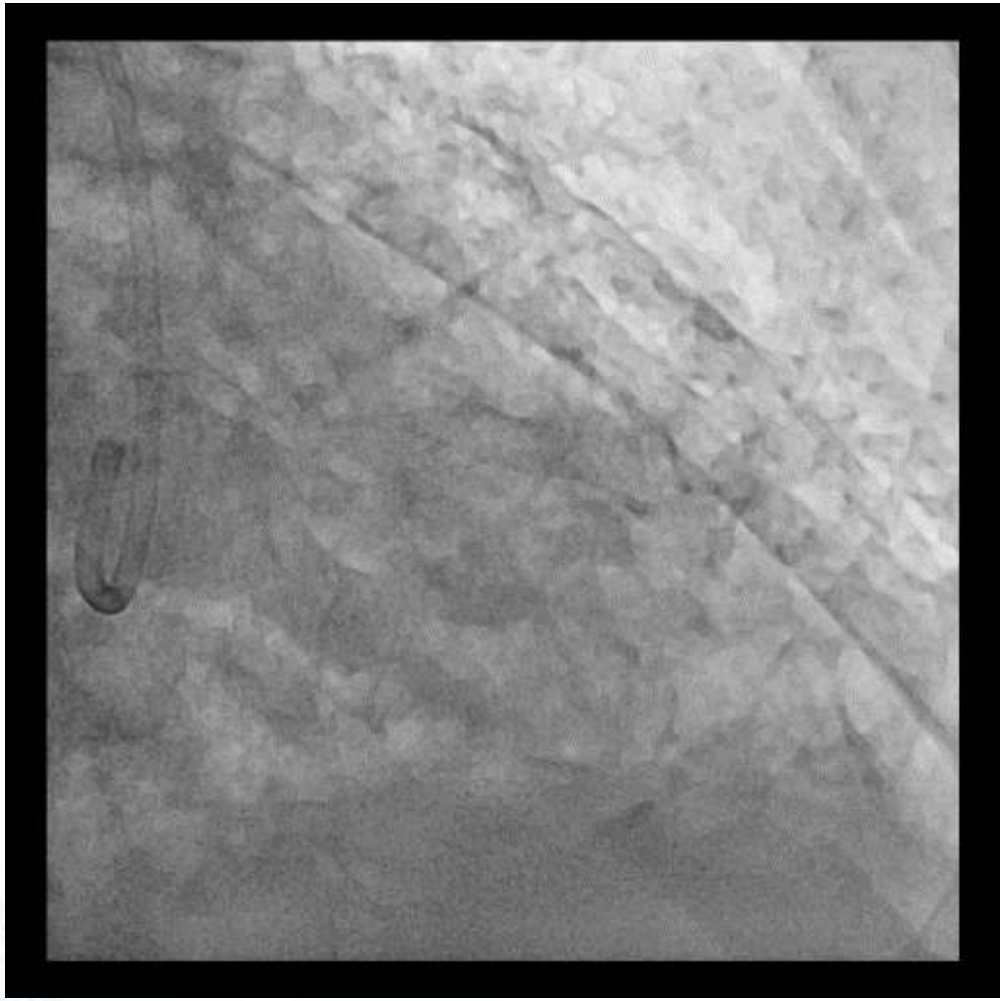
Crossover Stenting

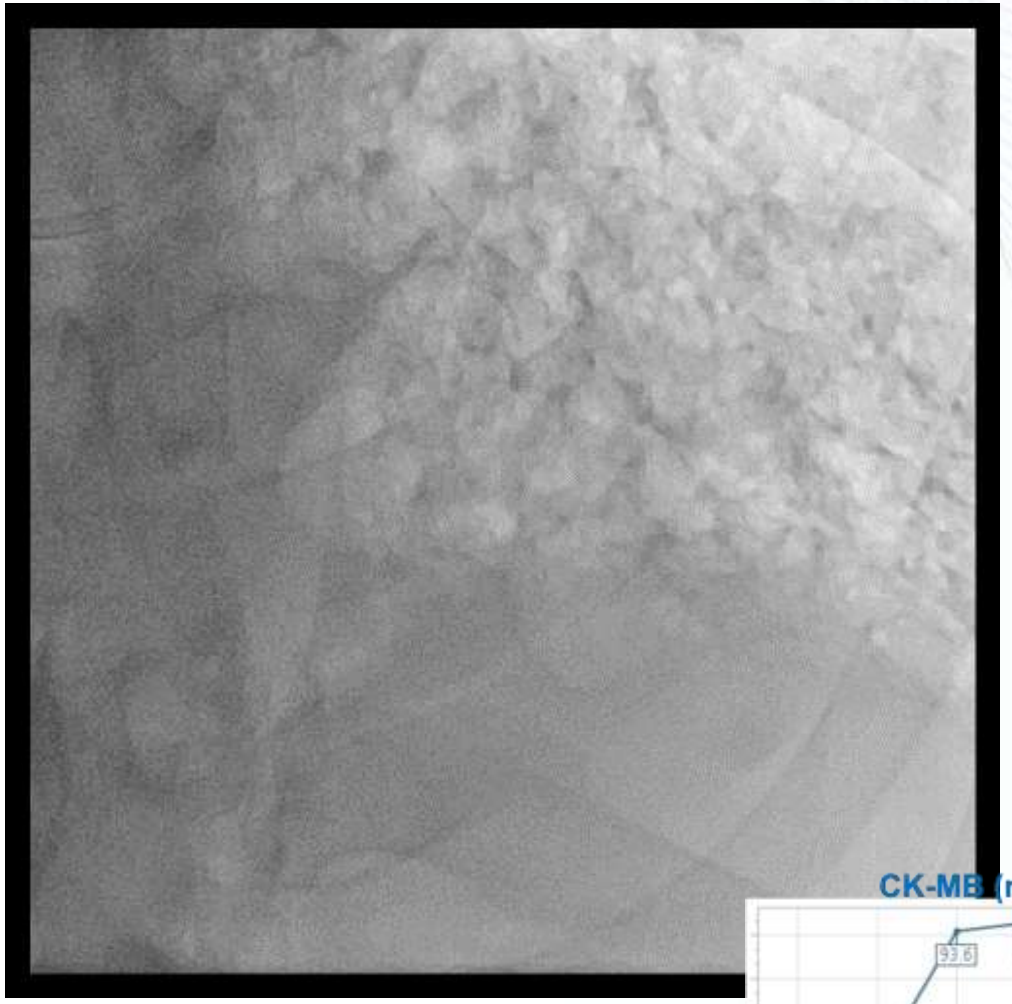
- LAD FFR 0.70



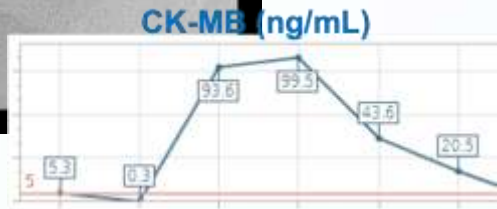
DES 4*22 mm

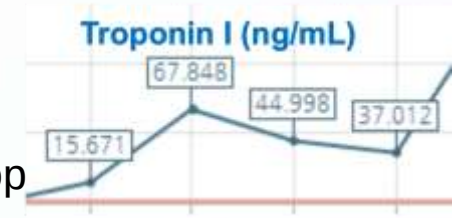
Re-wiring at Jailed Dx Failed .. Finished procedure





Chest pain (+), EKG change (-)
but post-PCI enzyme increased



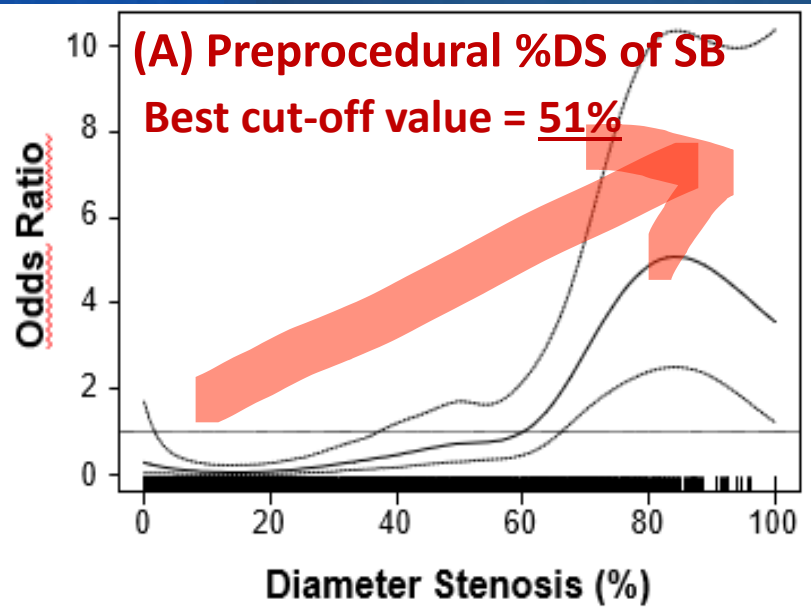


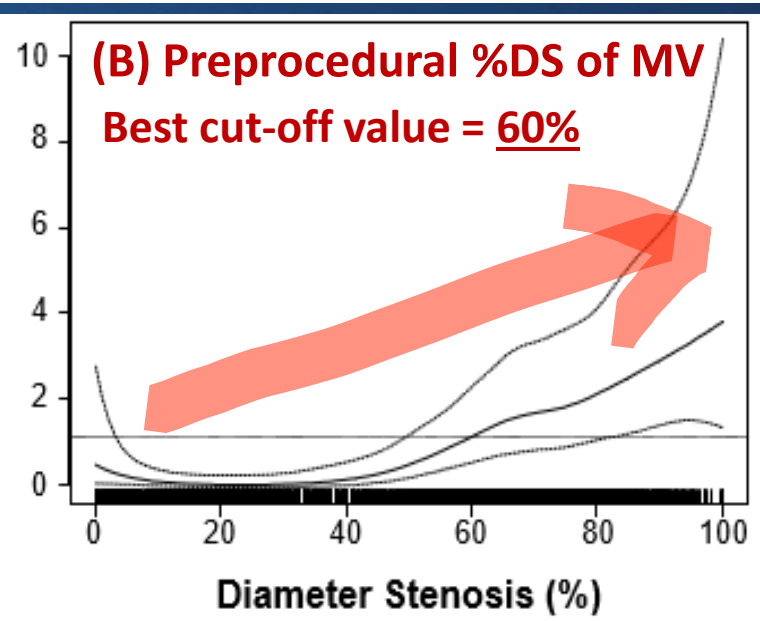
Presented by Dr Do-Yoon Kang @ 2023 TCTAP Workshop

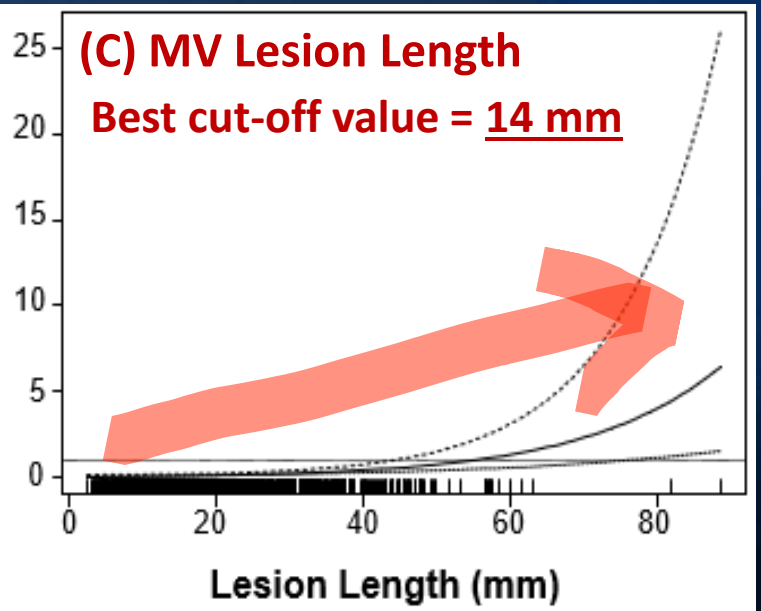
Risk factors of final SB occlusion after MV stenting by 1-stent technique

Variables	Final SB Non-Occlusion	Final SB Occlusion	Odds Ratio (95% CI)
Preprocedural DS of MV			1.02 (1.01-1.04)
Preprocedural DS of SB			1.03 (1.02-1.05)
MV lesion length			1.03 (1.01-1.06)
Wire-jailing at SB			0.48 (0.25-0.91)

0.2 1 5



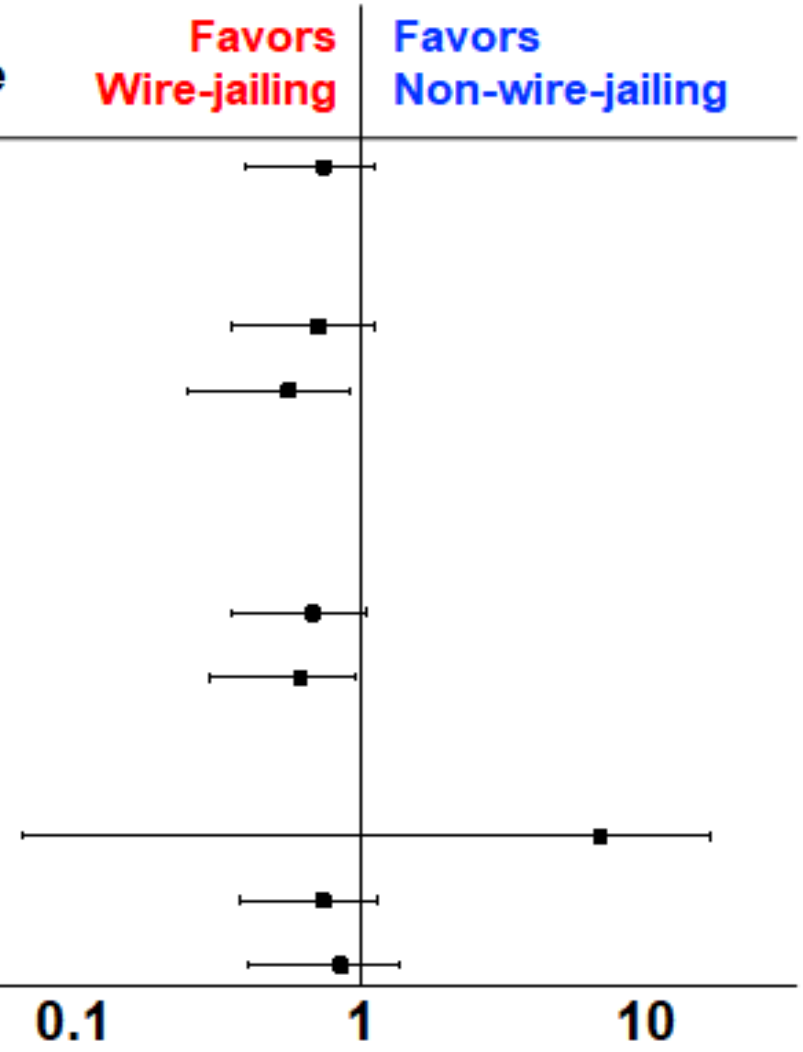




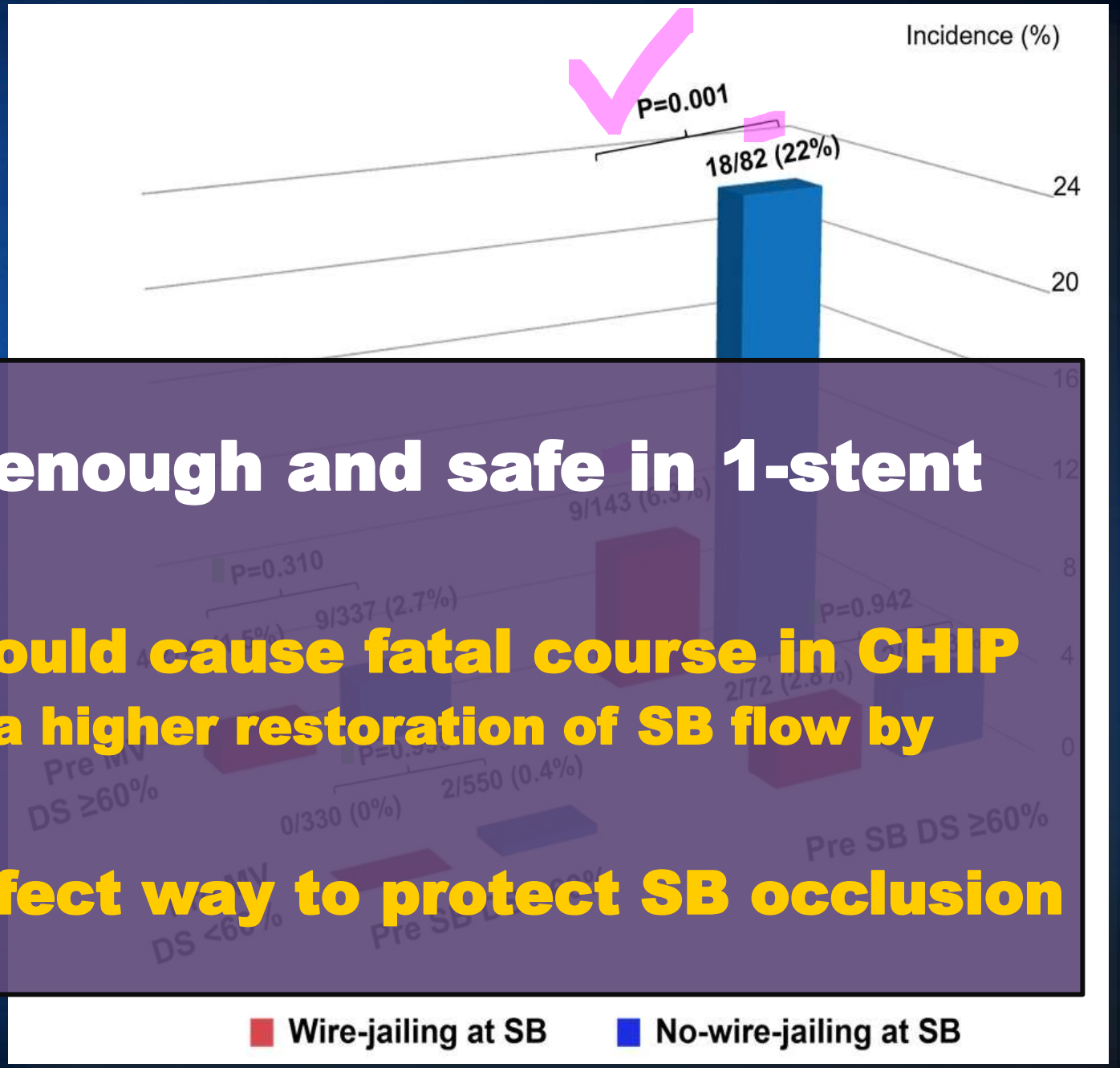
- The risks of SB occlusion progressively increased as the pre-procedural DS of the SB and MV increased and the lesion length at the MV increased.

Comparison of Final SB Occlusion according to the Disease Severity (Stenoses at the SB or MV and Lesion Length) and Wire Jailing @ SB

Subgroup	No./Total (%) Wire-jailing	Non-wire-jailing	OR(95% CI)	p-value
Overall	15/819 (1.8)	31/1071 (2.9)	0.63 (0.33-1.15)	0.141
% DS of SB				
< 50	0/472 (0)	9/767 (1.2)	—	0.990
≥ 50	15/347 (4.3)	22/304 (7.2)	0.58 (0.29-1.13)	0.113
● ≥ 60	11/215 (5.1)	20/177 (11.3)	0.42 (0.19-0.89)	0.028
% DS of MV				
< 50	0/282 (0)	3/493 (0.6)	—	0.995
≥ 50	15/537 (2.8)	28/578 (4.8)	0.56 (0.29-1.05)	0.079
● ≥ 60	13/417 (3.1)	27/439 (6.2)	0.49 (0.24-0.95)	0.039
MV lesion length				
< 10 mm	1/152 (0.7)	1/168 (0.6)	1.11 (0.04-28.13)	0.943
≥ 10 mm	14/667 (2.1)	30/903 (3.3)	0.62 (0.32-1.16)	0.150
≥ 14 mm	13/456 (2.8)	27/674 (4.0)	0.71 (0.34-1.43)	0.311



Incidence of final SB occlusion according to wire jailing at SB and severity of stenosis of SB or MV



- The wire-jailing group had a significantly lower incidence of final SB occlusion in the lesions with pre-procedural DS of SB or ≥60% and MV of <60% (OR 0.29; 95% CI: 0.12-0.69; P = 0.007).
- However, in the lesions with pre-procedural DS of the SB of ≥60% or MV of <60%, there were no significant differences in the incidence of final SB occlusion between groups.

- **Is "Wire-jailing @SB" enough and safe in 1-stent bifurcation PCI ?**
  - **Abrupt SB occlusion could cause fatal course in CHIP PCI/patients (even with a higher restoration of SB flow by wire-jailing @SB).**

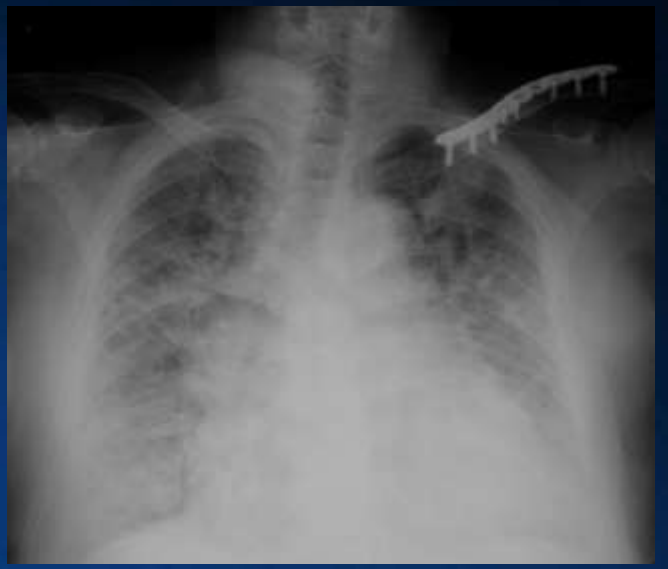
→ We need a more perfect way to protect SB occlusion

Choi YJ, Lee SJ, Kim BK, et al. J Am Coll Cardiol Intv 2022;15:443–55.

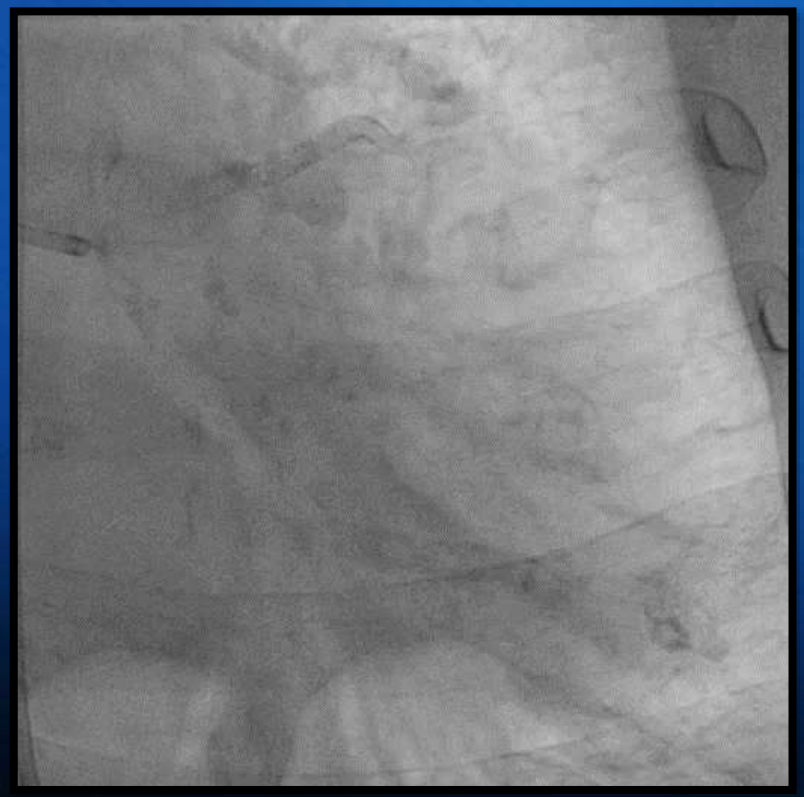
Case. F/85

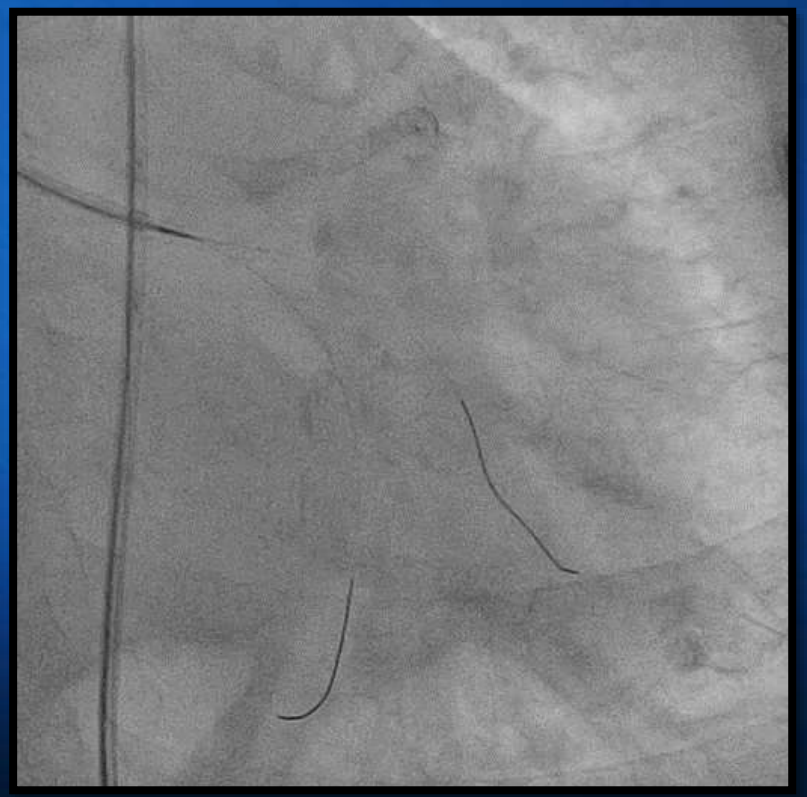
158cm/57.4kg, BSA: 1.59/m^2; Risk factors; HTN, DM, Atrial fibrillation

- C.C; dyspnea for 2 days & Diagnosed NSTEMI
- Hx; s/p PCI @ m-d-LAD (Xience 2.75x38 & 3.0x38) 1 months ago
- Echo; Newly developed RWMA at LCx territory, decreased EF (70%->**35%**)



CAG @ ER (No IC of RCA & Patent LAD stents & aggravated LCx Lesions)



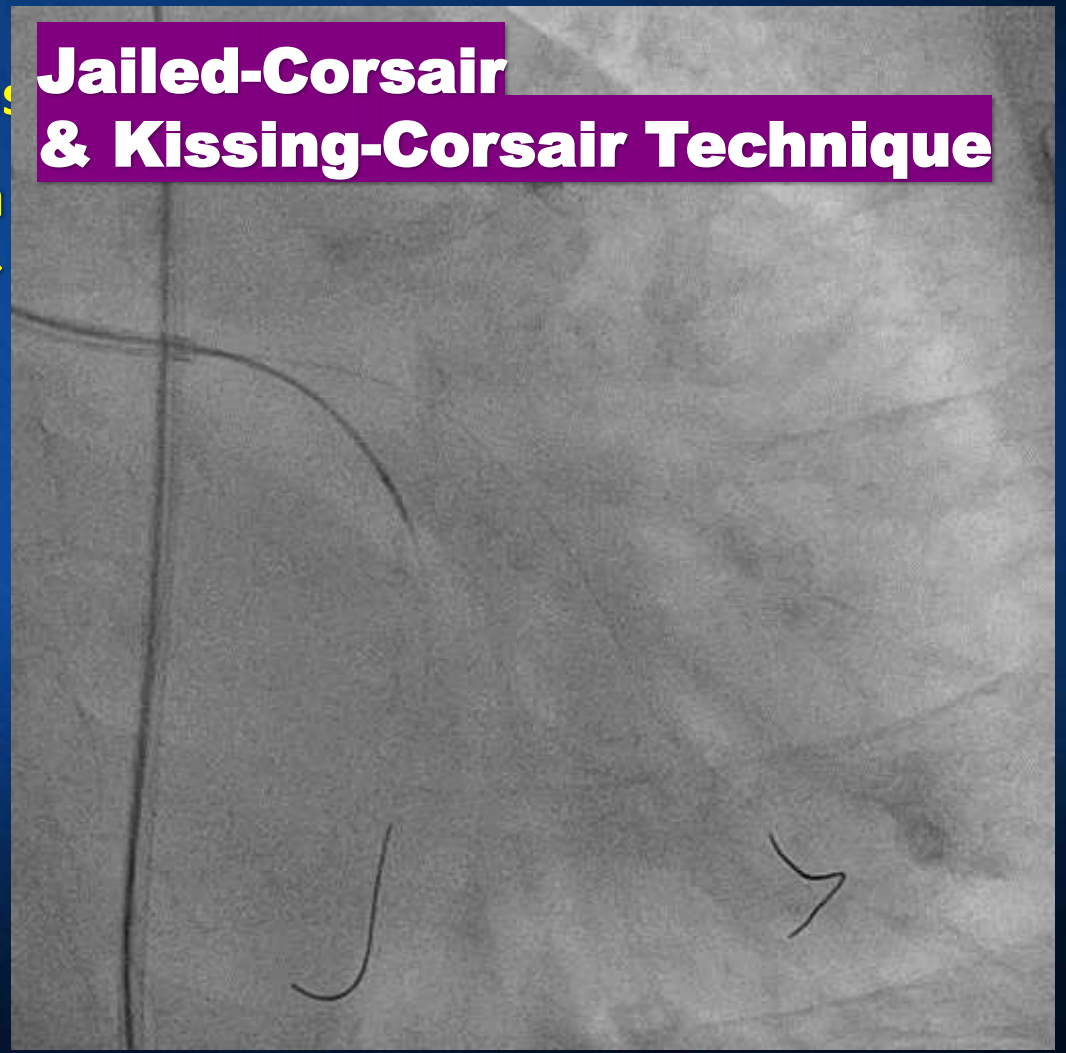


PCI of LCx (big OM)

- Double 014" G/W using **Corsair supporting for the safe & efficient wiring** (for the prevention of flow-inhibition due to the wiring-difficulty)
- **Corsair dilation for the tight tortuous lesion ... definitely better than the use of small-sized balloon**

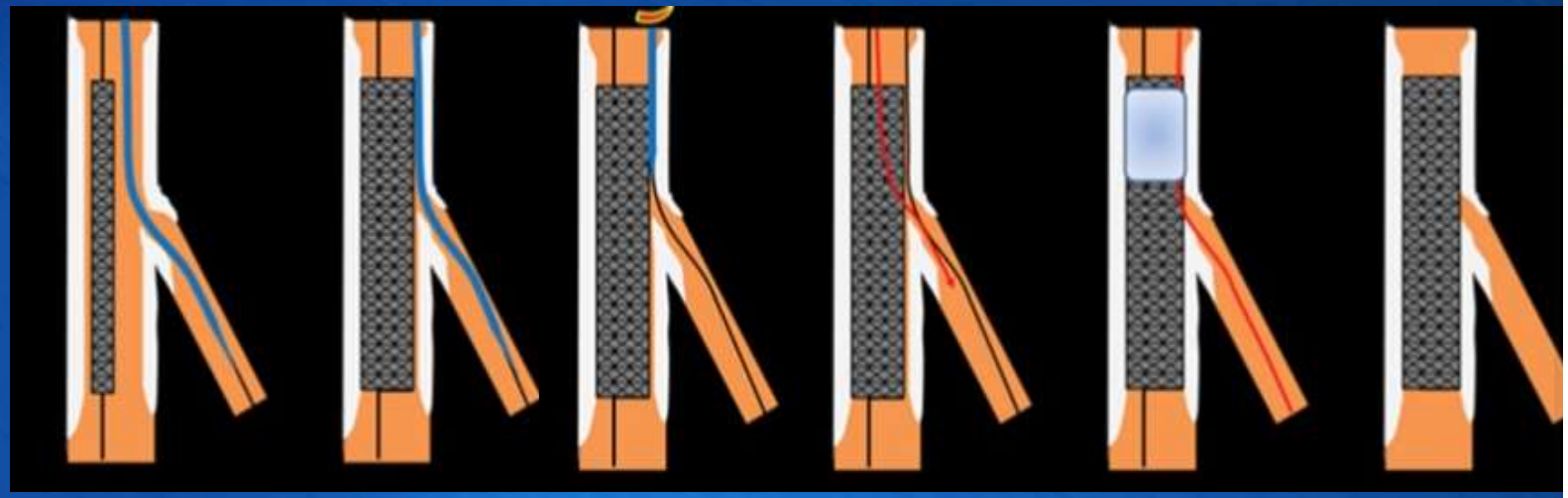
Protection of side branch … acute HF & pul edema in old -aged patient

- Elective 2-stenting for OM & LCx proper
  → benefit < risk d/t ↑procedure time
- Simple wire jailing (KIO)
  → risk of abrupt SB occlus
- Pre-ballooning or balloon
  → risk of SB dissection ↑



Jailed Corsair technique

The jailed wire or balloon technique could not always prevent SB occlusion.

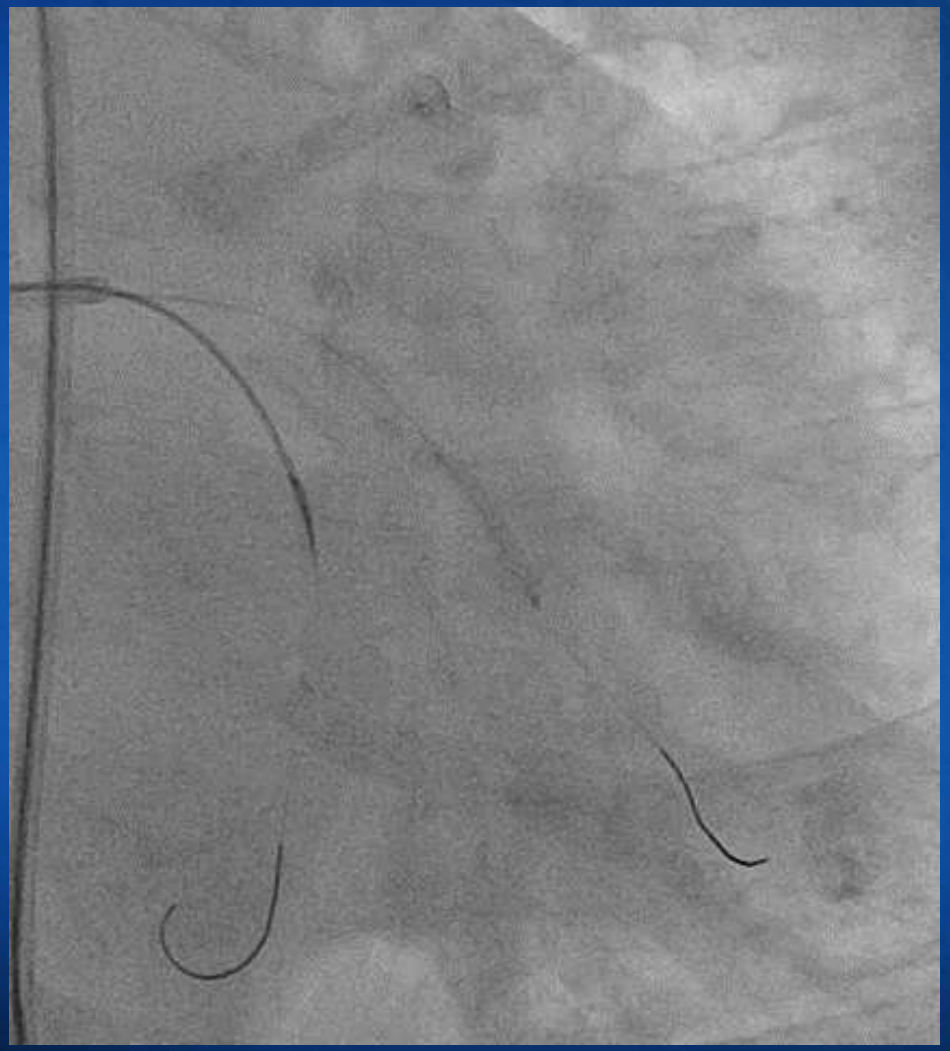


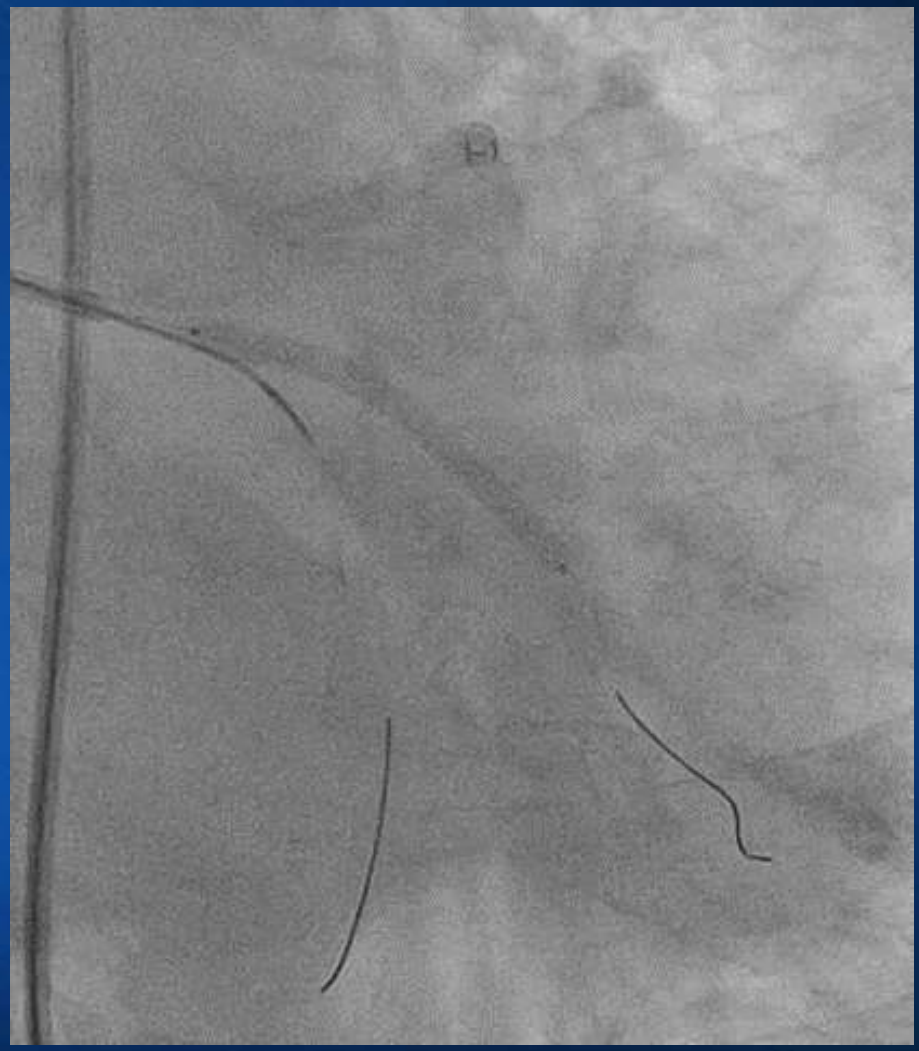
- The similar technique to the jailed balloon technique.
- Advantage
  - **Few risk of dissection at the SB ostium**
  - **Facilitating guide-wire recross to SB**

	Jailed Corsair Technique	Jailed Balloon Technique
Purpose	Side branch protection	Side branch protection
Risk of dissection at the ostium of side branch	Minimum	Depends on the size of balloon and inflation pressure
Difficulty level of guidewire recross to the side branch	Easy	Depends on the dissection at the ostium of side branch
Inflation pressure of stent implantation	Nominal or less than nominal	Nominal. Should be greater than inflation pressure of the jailed balloon
Predilatation and/or lesion modification to main vessel before stent implantation	Critically important. Sufficient lesion preparation enables stent expansion with minimum inflation pressure.	Should be important.
Removal of the jailed device	Pull back with rotating Corsair	Pull back without rotating balloon
Advantage	Few risk of dissection at the ostium of side branch, which facilitates guide wire recross to side branch	There are several literatures supporting the efficacy and safety of this procedure.
Possible complications	Entrapment, Tip transection	Entrapment, Jailed balloon rupture

Numasawa Y, et al. Cardiovasc Revasc Med. 2017;18:295-298.

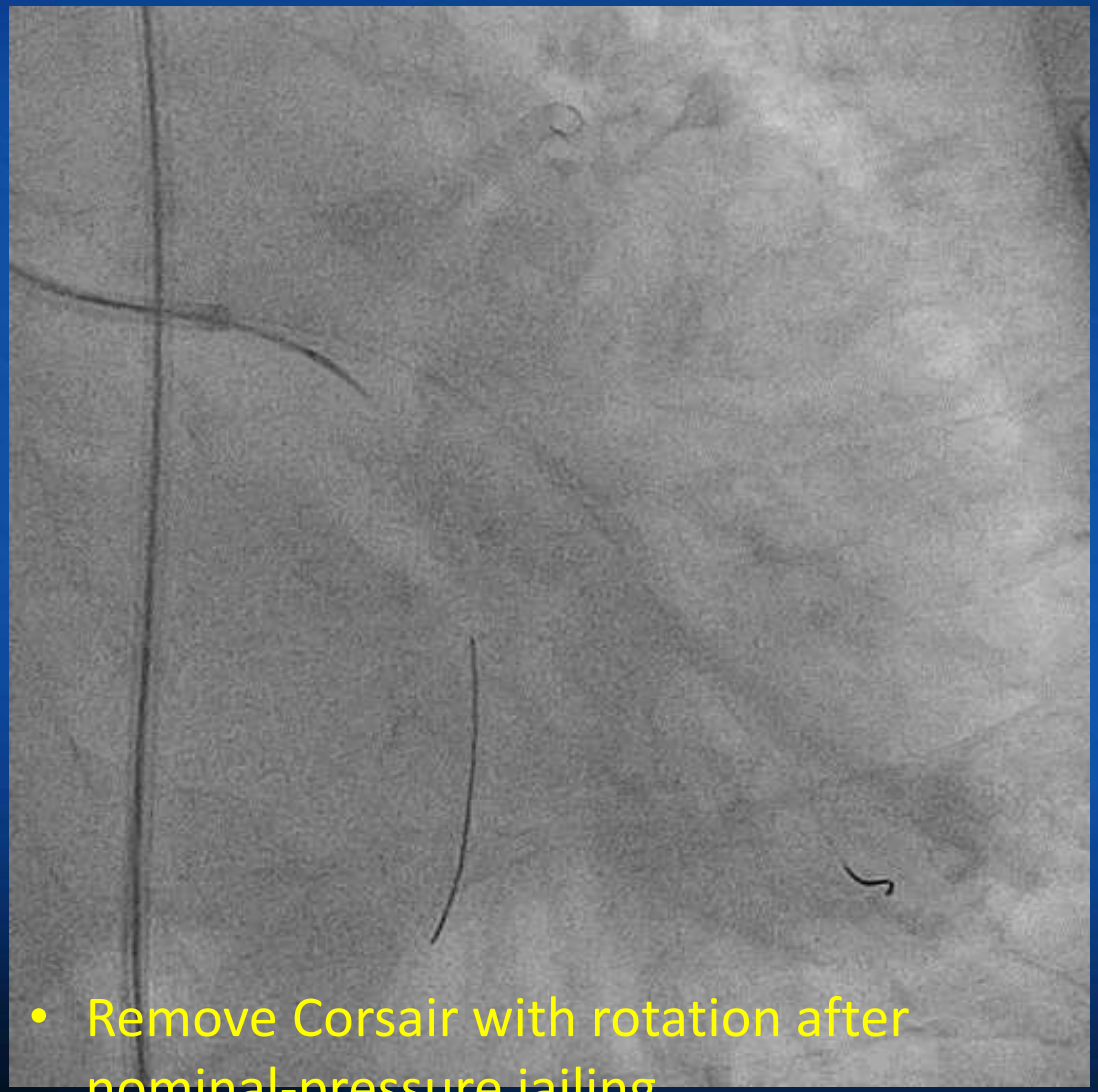
Pre-dilation & stenting using "Jailed Corsair technique"



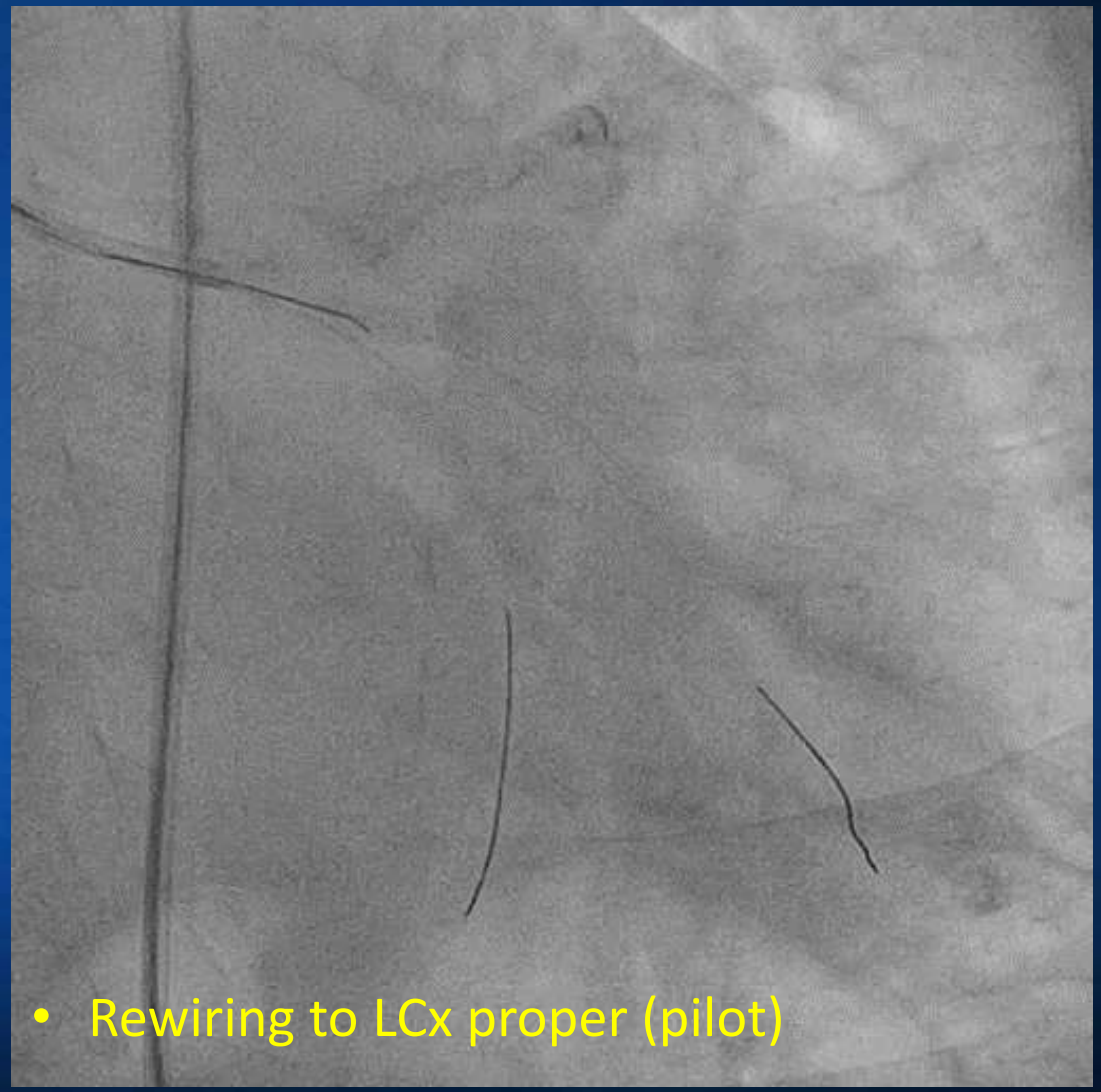


- 2.5x14mm sized semi-balloon
- Synergy 3.0x38 (nominal pr,11 atm) with jailed corsair @ LCx proper

Jailed-Corsair & Kissing-Corsair Technique

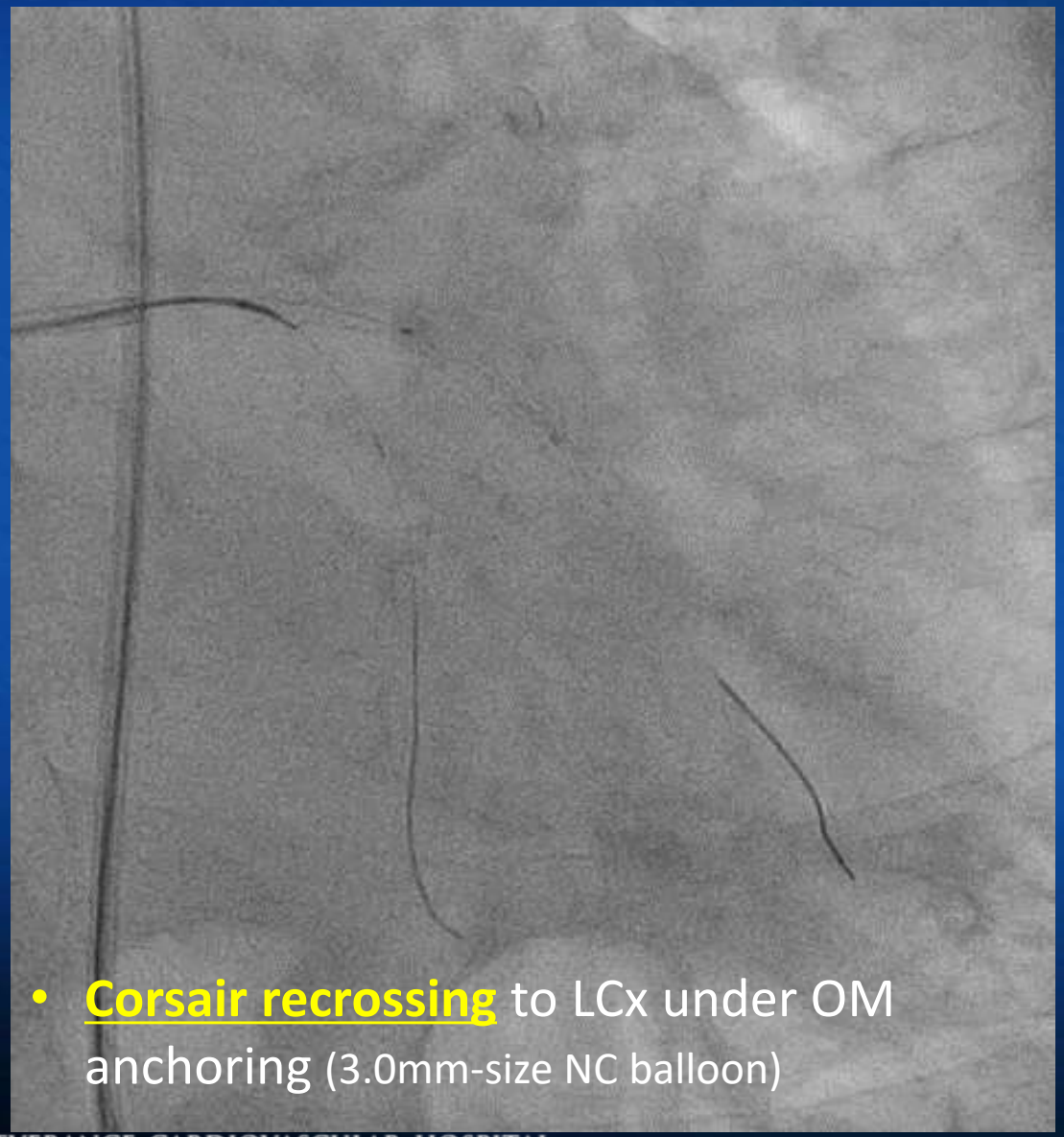


- Remove Corsair with rotation after nominal-pressure jailing

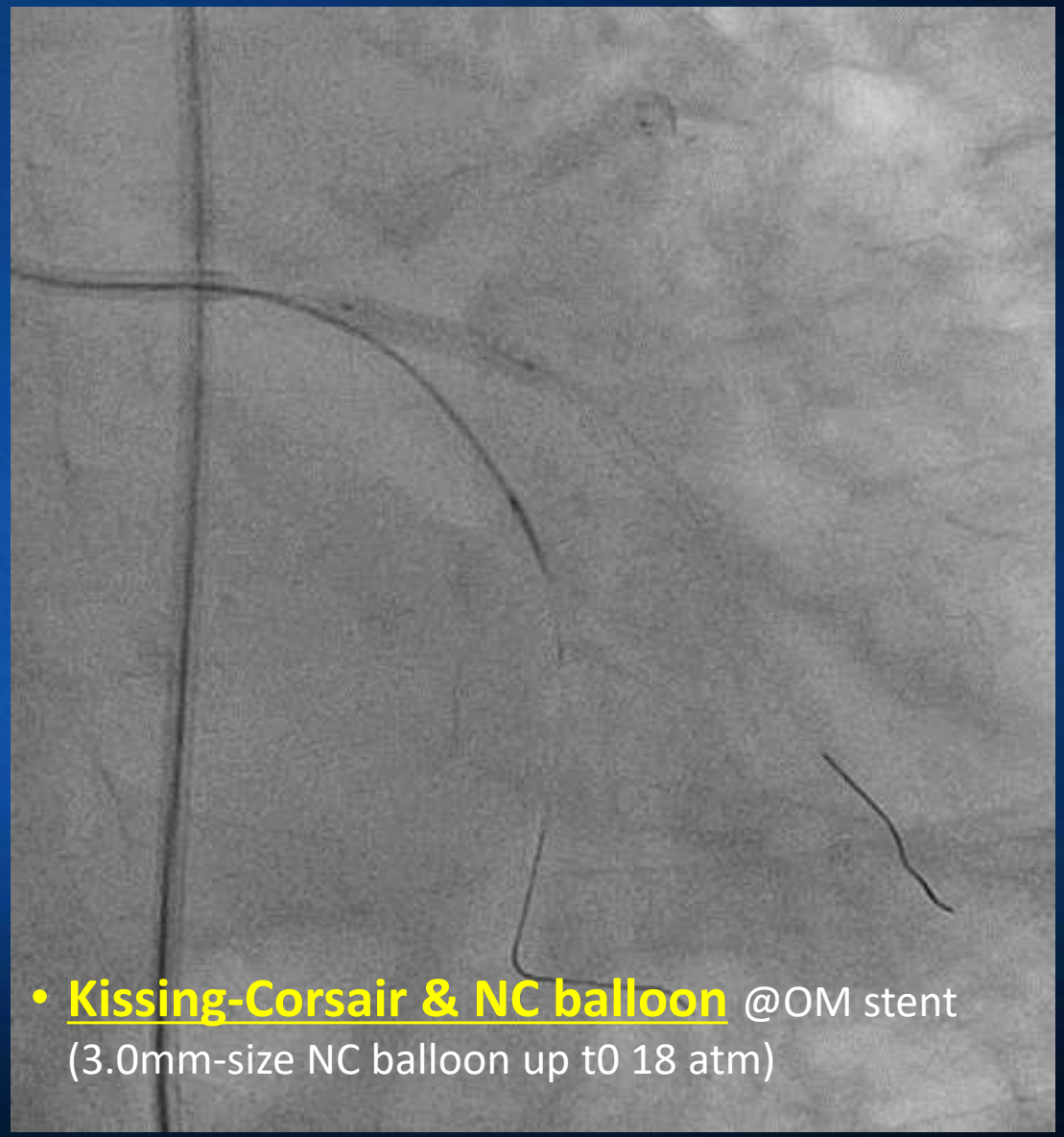


- Rewiring to LCx proper (pilot)

Jailed-Corsair & Kissing-Corsair Technique



- **Corsair recrossing** to LCx under OM anchoring (3.0mm-size NC balloon)



- **Kissing-Corsair & NC balloon** @OM stent (3.0mm-size NC balloon up t0 18 atm)

Final angiography


Case Report

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Consecutive Jailed- and Kissing-Corsair Technique: Side Branch Protection and Dilation during Stent Implantation

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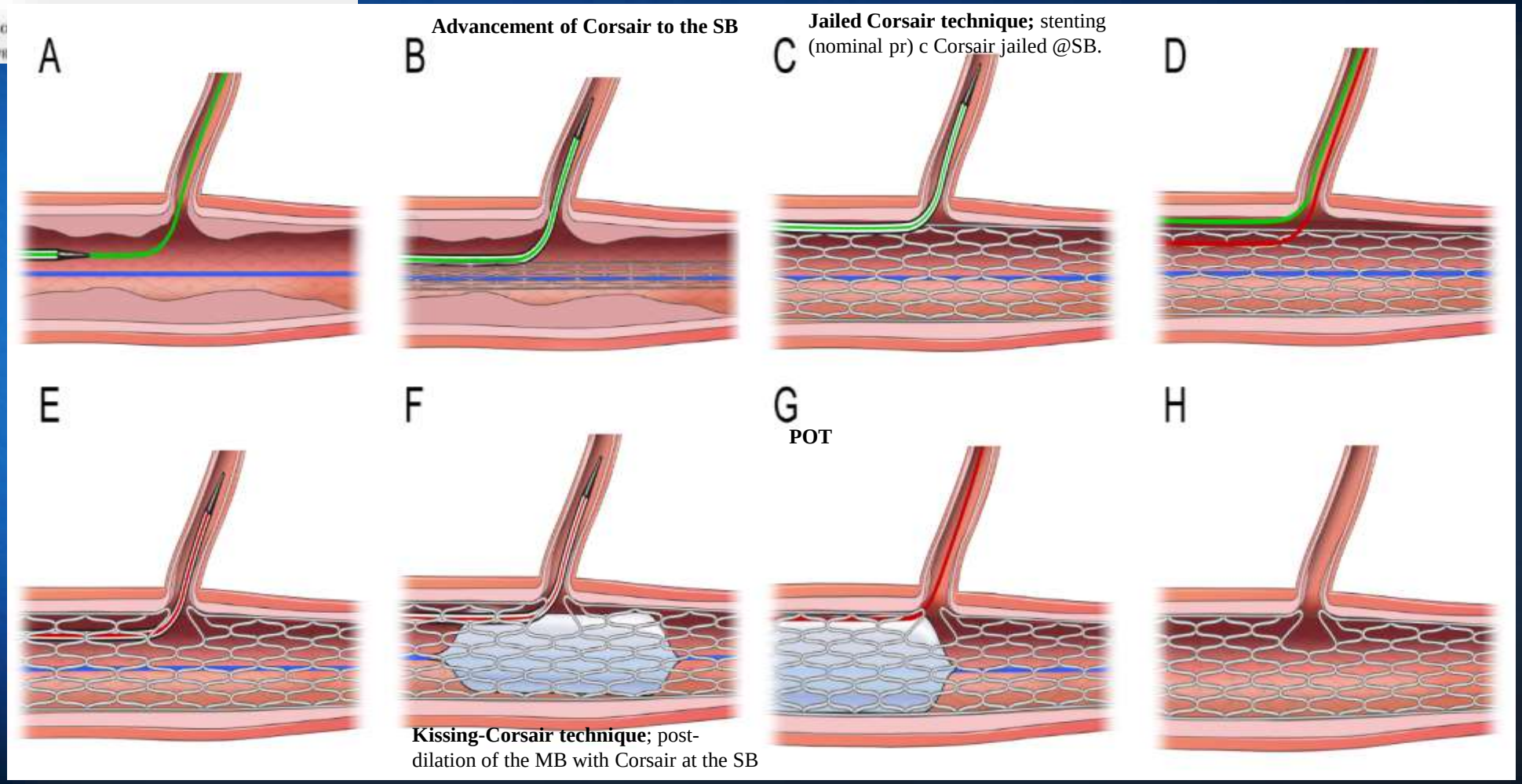
- After jailed-Corsair, kissing-Corsair technique (1-mm Corsair shaft serves as a small balloon, providing the quasi-effect of the kissing balloon technique) performed consecutively.
- Option for Tx of patients in whom small balloons cannot pass the SB.



Choi J & Kim BK, et al. 2019 YMJ. Nov;60(11):1108-1111

SB Protection Techniques of 1-stent bifurcation PCI

- In overall bifurcation lesions treated with the 1-stent strategy, wire jailing @ SB was not associated with a reduced risk of final SB occlusion after MV stenting.
  → **Routine wire jailing @ SB does not need to be recommended.**

- **Wire jailing @ SB before MV stenting was a protective factor against final SB occlusion !!**
  - In the **lesions with pre-procedural DS of SB of ≥60% and MV of ≥60% (severe stenosis of both SB and MV /true bifurcation), wire jailing** was significantly associated with a lower incidence of final SB occlusion than was non–wire jailing.

- **In case of bifurcation lesions requiring a more perfect SB protection without risks of SB ostial dissection, the Consecutive Jailed-Cosair and Kissing-Corsair technique could be good option (for patients with SB which need to be desperately protected without procedural time-delay (CHIP patients not using LV-assisted devices).**