Practical Tips and Tricks of Intravascular Lithotripsy for Severely Calcified Coronary Lesions

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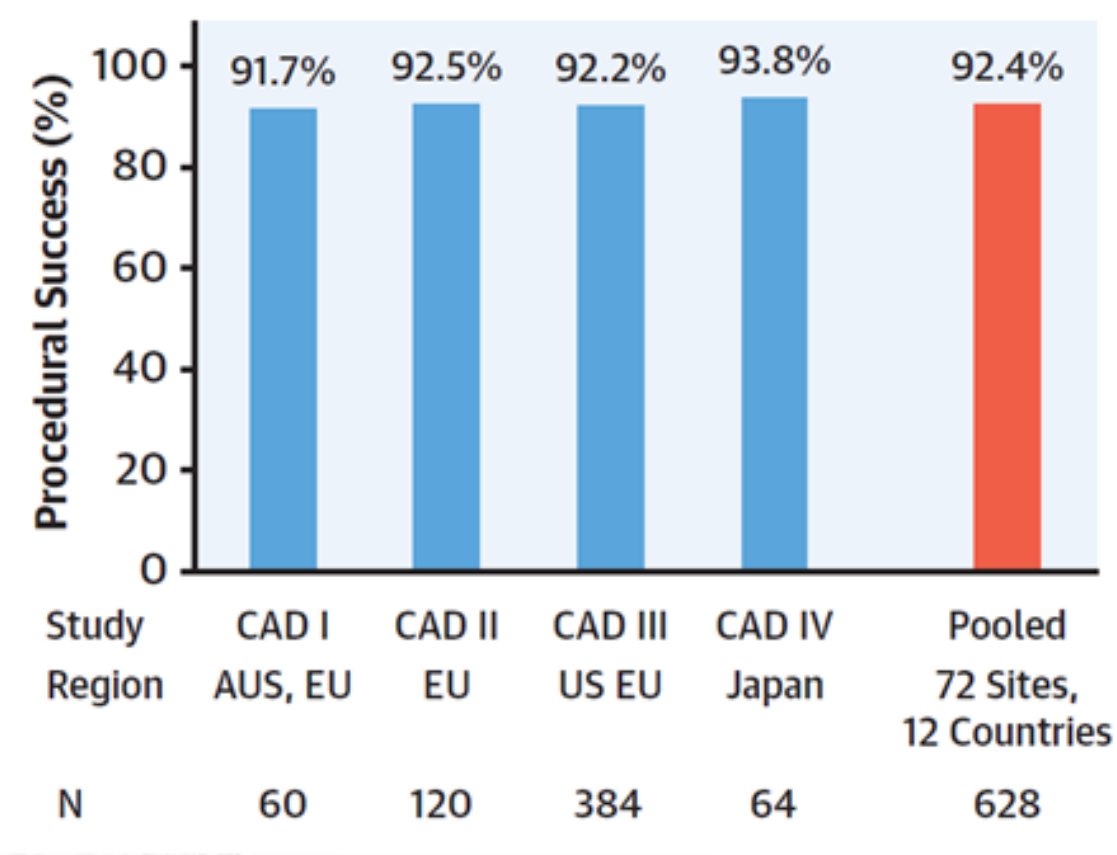
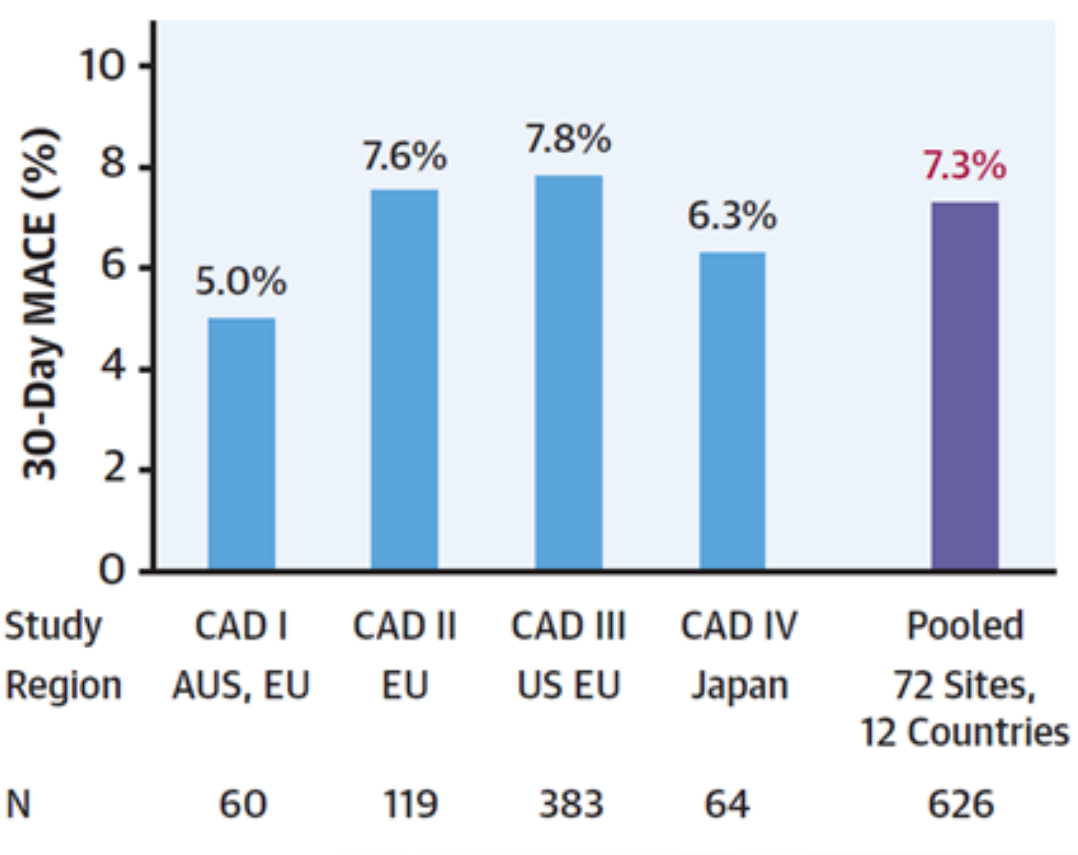
Disclosure

- Received speaking honorarium from Abbott, Boston Scientific, Shockwave
- Received consultant fee from Abbott, TERUMO

Safety and effectiveness of coronary IVL

High procedural success rate and low incidence of adverse events have been demonstrated

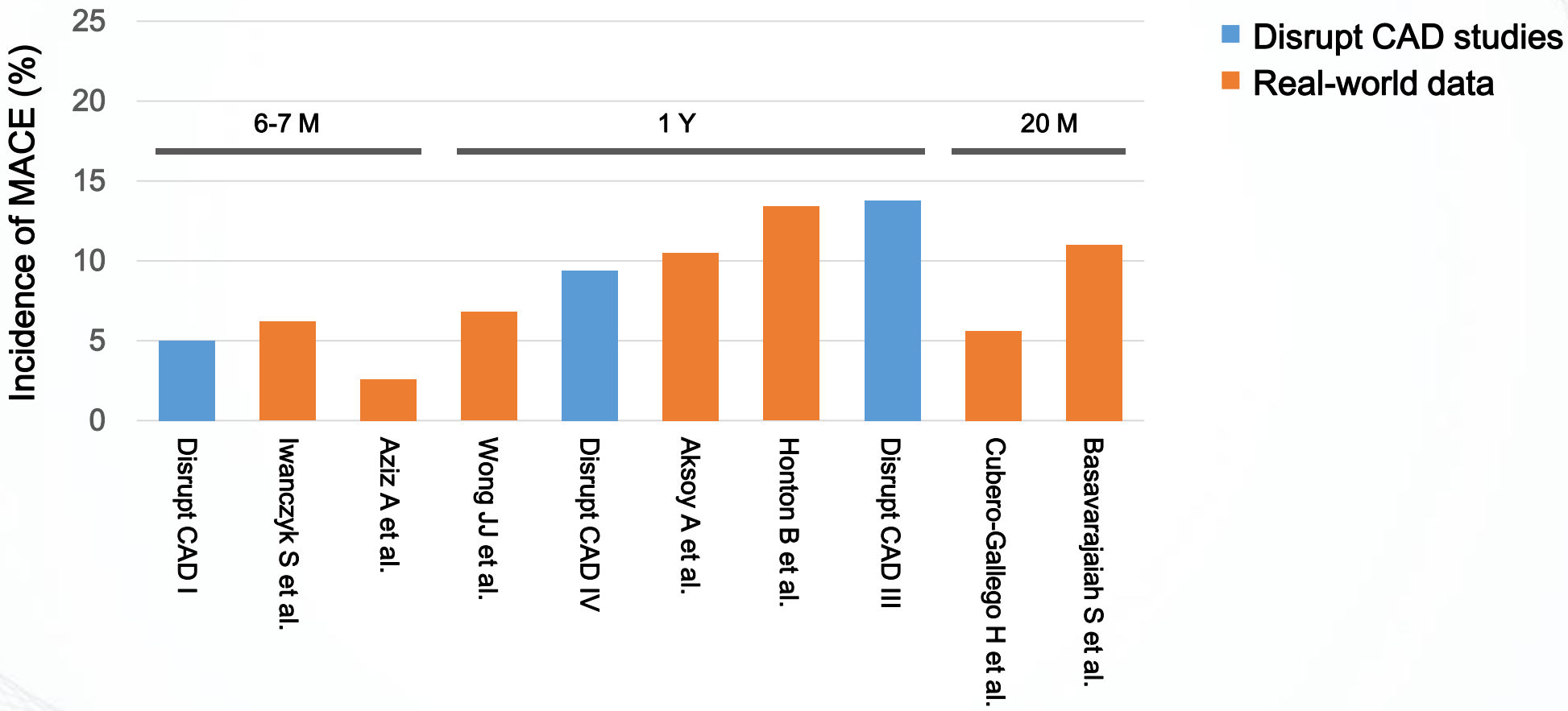




Kareiakes DJ, et al. J Am Coll Cardiol Intv. 2021

Safety and effectiveness of coronary IVL

Relatively low rate of MACE at mid & long-term follow-up has been demonstrated



Safety and effectiveness of coronary IVL

Very low rate of complications during procedure using IVL

TABLE 4 Angiographic Complications With Coronary Calcium Modification Technologies

	IVL	Rotational Atherectomy	Orbital Atherectomy	Laser Atherectomy
Study	Disrupt CAD I, Disrupt CAD II, Disrupt CAD III, Disrupt CAD IV (25,30,56,73)	PREPARE-CALC (77)	ORBIT II (78)	Bilodeau et al. (79)
n	60, 120, 384, 64	100	443	95
Moderate to severe Ca^{++}, %	94.2-100	100	100*	80%†
Angiography core laboratory	Yes	Yes	Yes	Yes
In-hospital MI, %	5.0-6.8‡	2.0§	9.3‡	2.1
Dissection (types D-F), %	0.0-0.3	3.0‖	0.9¶	5.3¶
Perforation, %	0.0-0.3	4.0	0.9	0.0
Abrupt closure, %	0.3	NR	0.2	0.0
Slow flow, %	0.0	2.0#	0.5	0.0
No reflow, %	0.0	–	0.0	–

Kareiakes DJ, et al. J Am Coll Cardiol Intv. 2021

Safety and effectiveness of coronary IVL

Ease-of-use is demonstrated as the similar outcomes between the 'roll-in' and 'pivotal'

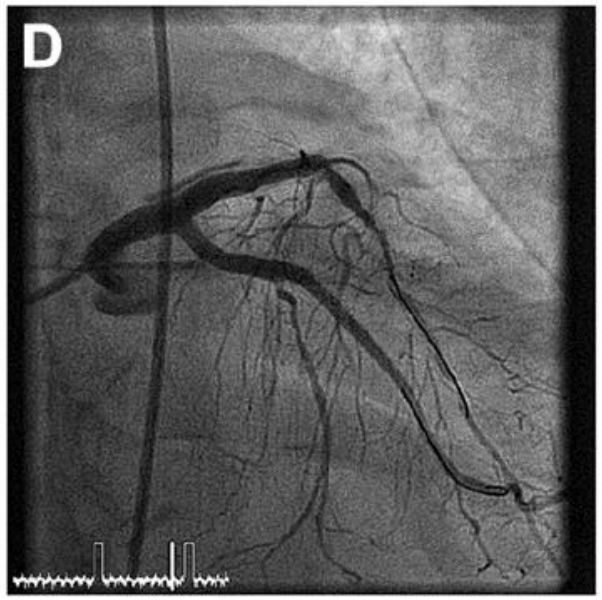
Patient characteristic	Roll-in (n=47)	Pivotal (n=384)	P-value
Outcomes			
Freedom from 30-day MACE	42 (89.4)	353/383 (92.2)	0.57
Procedure success†	41 (87.2)	355 (92.4)	0.25
Device crossing success‡	44 (93.6)	368 (95.8)	0.45

Hill JM, et al. J Am Card Cardiol. 2020

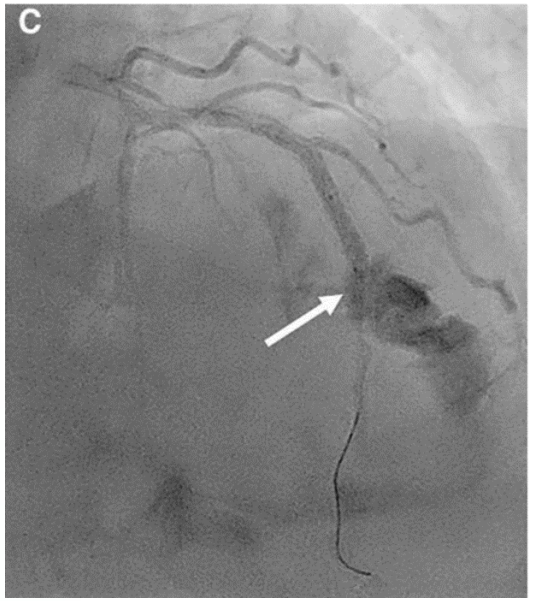
Potential complications of IVL

Interventionalists have to keep in mind potential serious complications

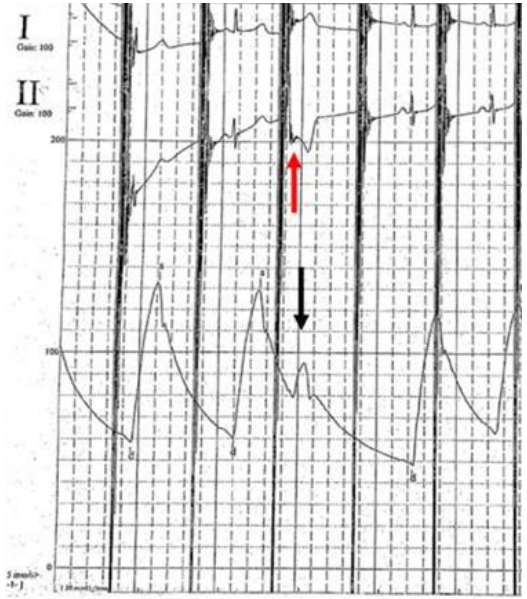
Extended dissection



Vessel perforation



BP reduction

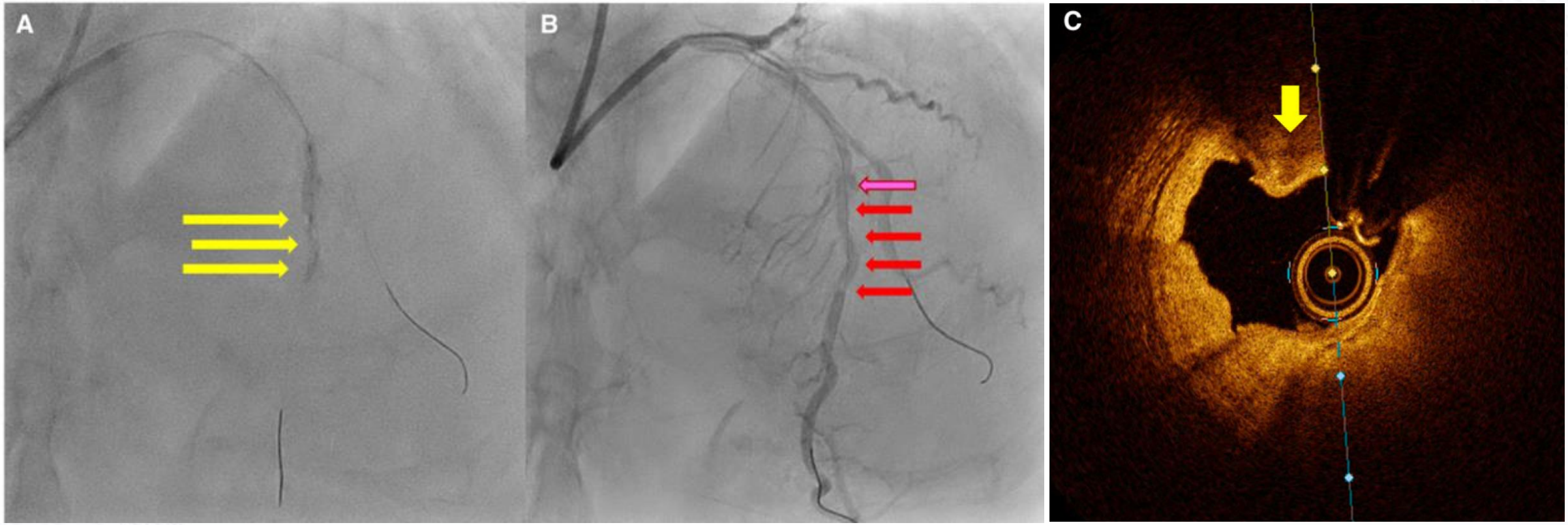


VT/VF

López-Lluva MT, et al. J Am Coll Cardiol intv 2019
McGarvey M, et al. EHJ case rep. 2020
Galougahi KK, et al. Circ Cardiovasc Intv. 2020
Doost A, et al. EHJ Case Reports 2022

Potential complications of IVL

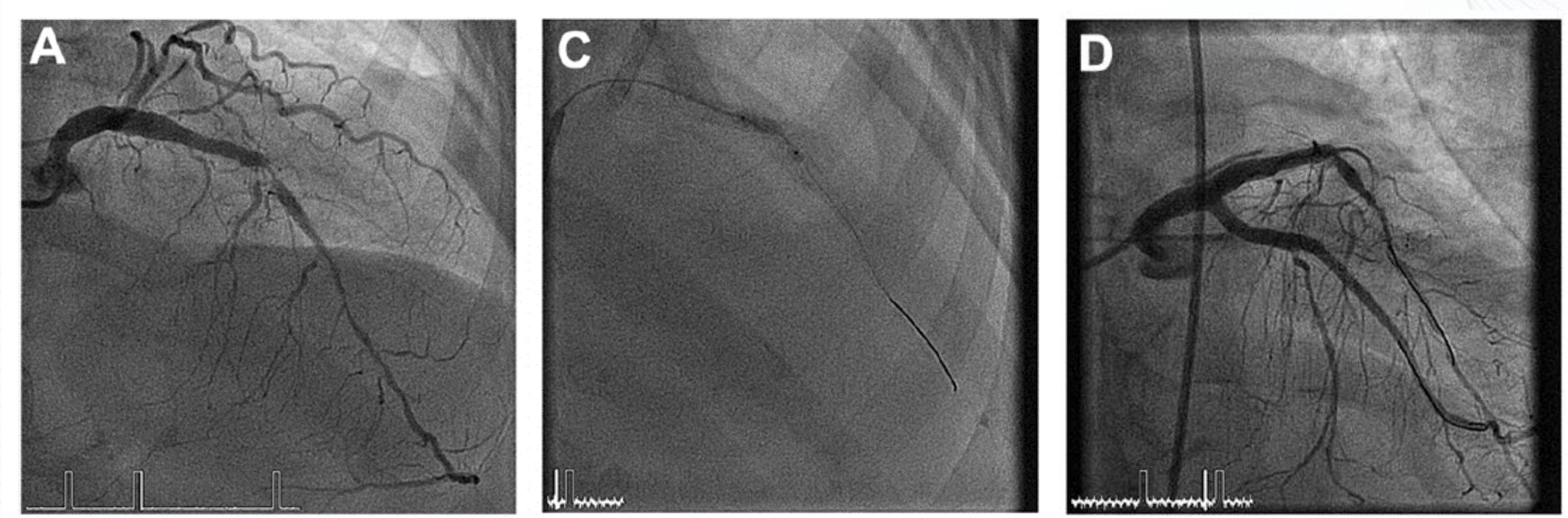
Protruded calcification, vessel tortuosity and forceful manipulation may cause balloon injury and rupture and subsequent spiral dissection



Lee TJ, et al. EHJ Case Reports 2021

Potential complications of IVL

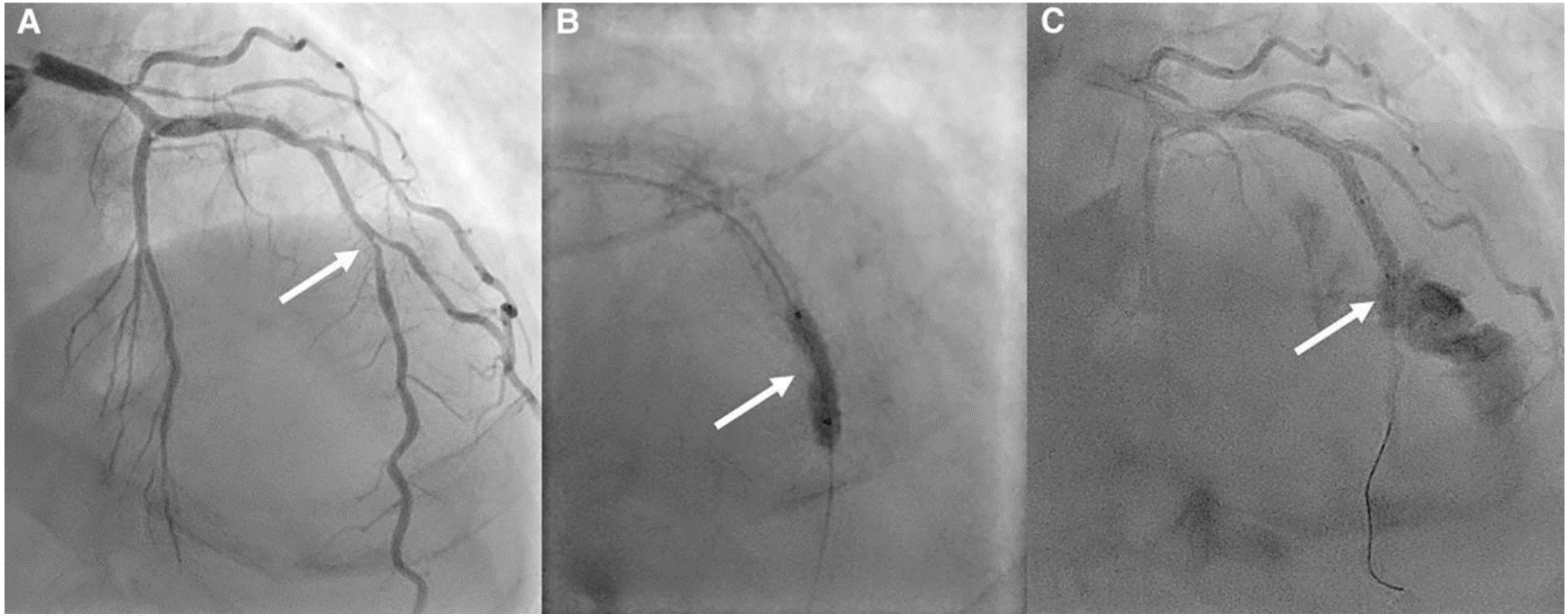
Balloon rupture during lithoplasty may generate a noncontrolled extended dissection



López-Lluva MT, et al. J Am Coll Cardiol Intv. 2019

Potential complications of IVL

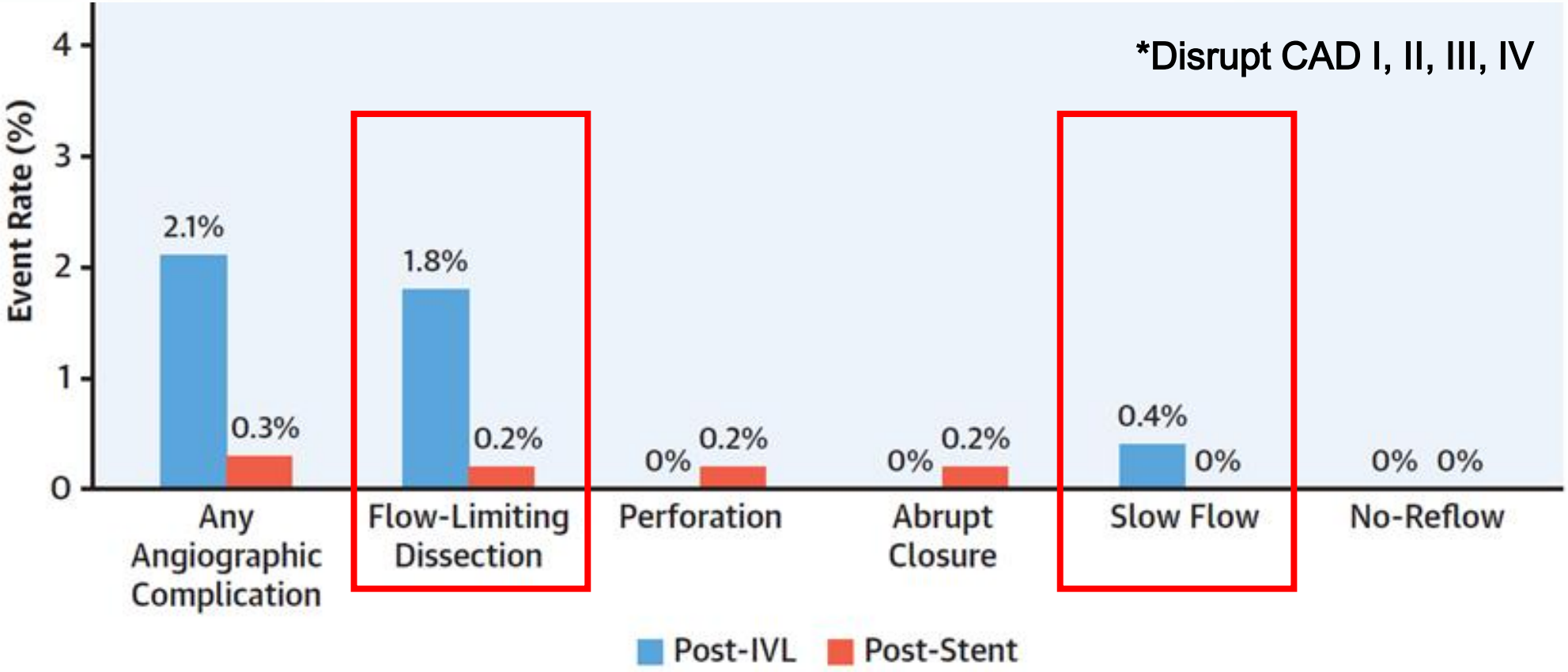
Further high-pressure post-dilatation after IVL resulted in coronary perforation



Doost A, et al. EHJ Case Reports 2022

Potential complications of IVL

IVL may cause balloon rupture and subsequent dissection, and post stent and high-pressure post dilatation may cause perforation



Kareiakes DJ, et al. J Am Coll Cardiol Intv. 2021

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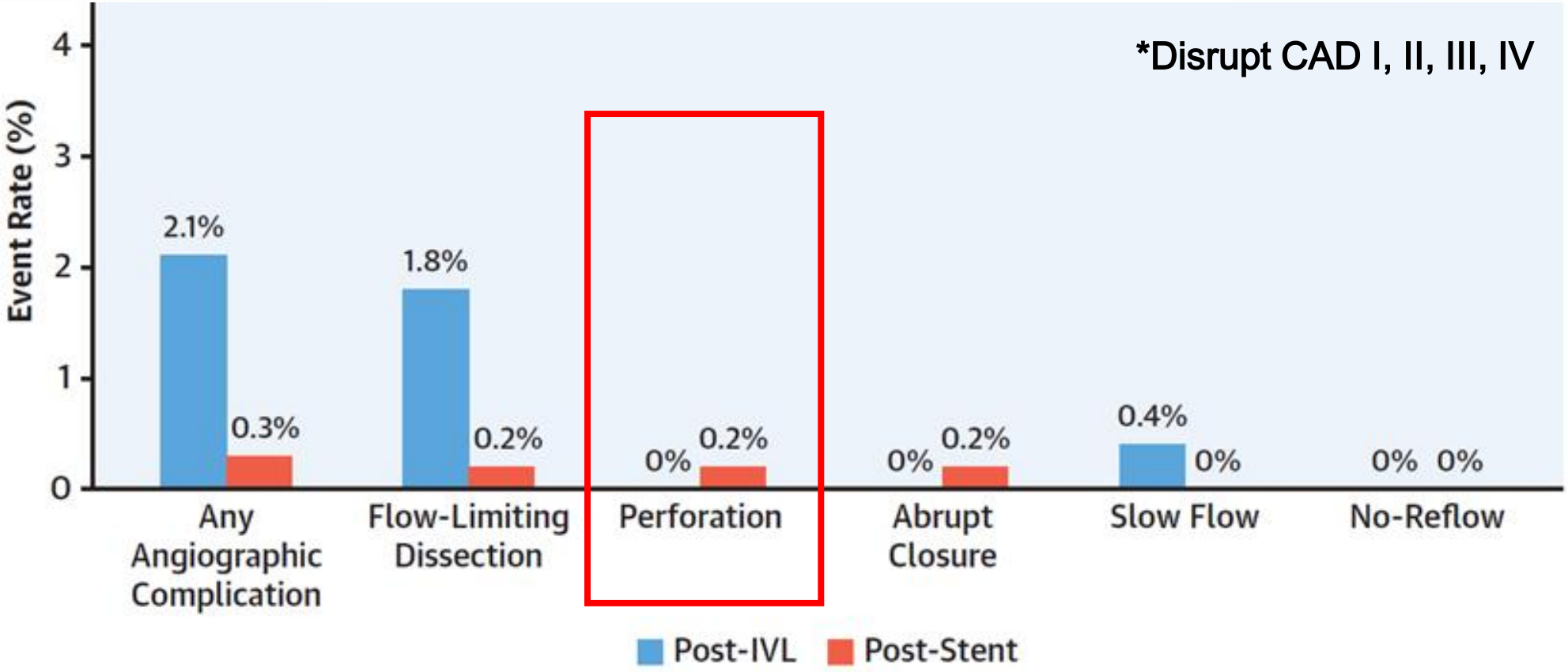
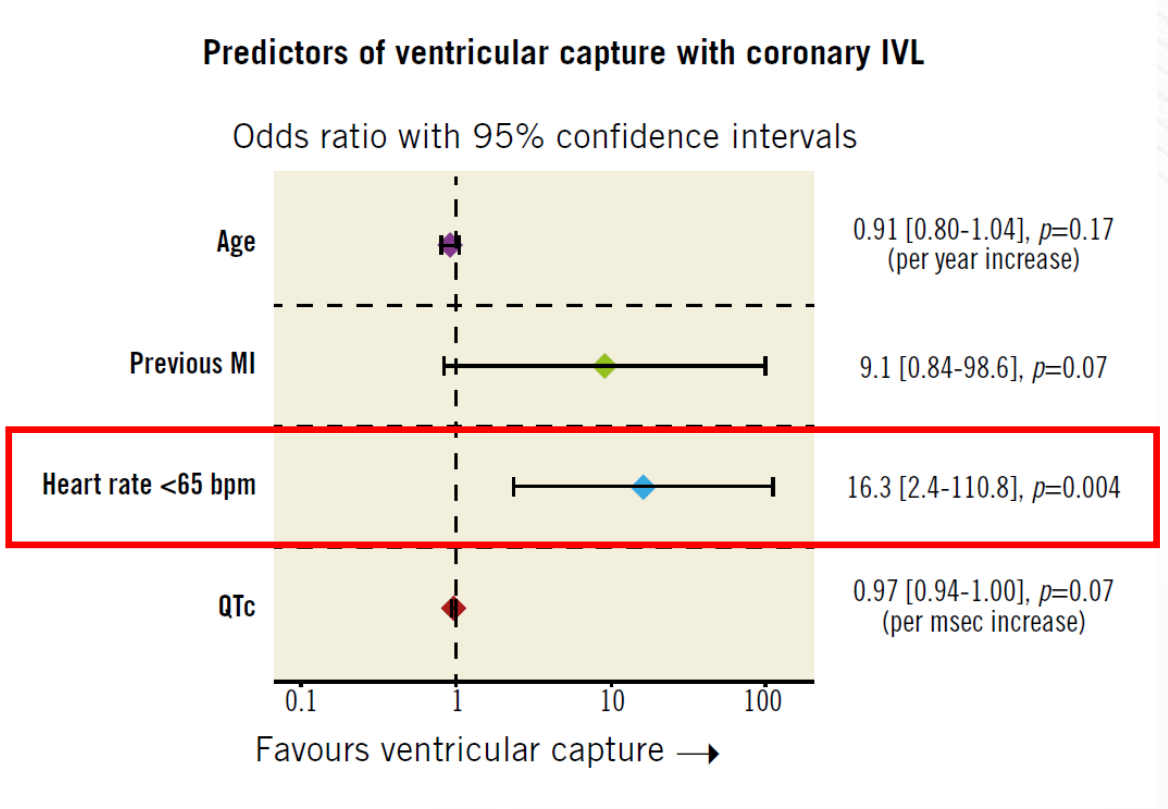


Kareiakes DJ, et al. J Am Coll Cardiol Intv. 2021

Potential complications of IVL

IVL–induced ectopic beats (shocktopics) are frequently observed, particularly in cases of bradycardia

Galougahi KK, et al. Circ Cardiovasc Interv. 2020



Wilson SJ, et al. Eurointerv. 2020

Potential complications of IVL

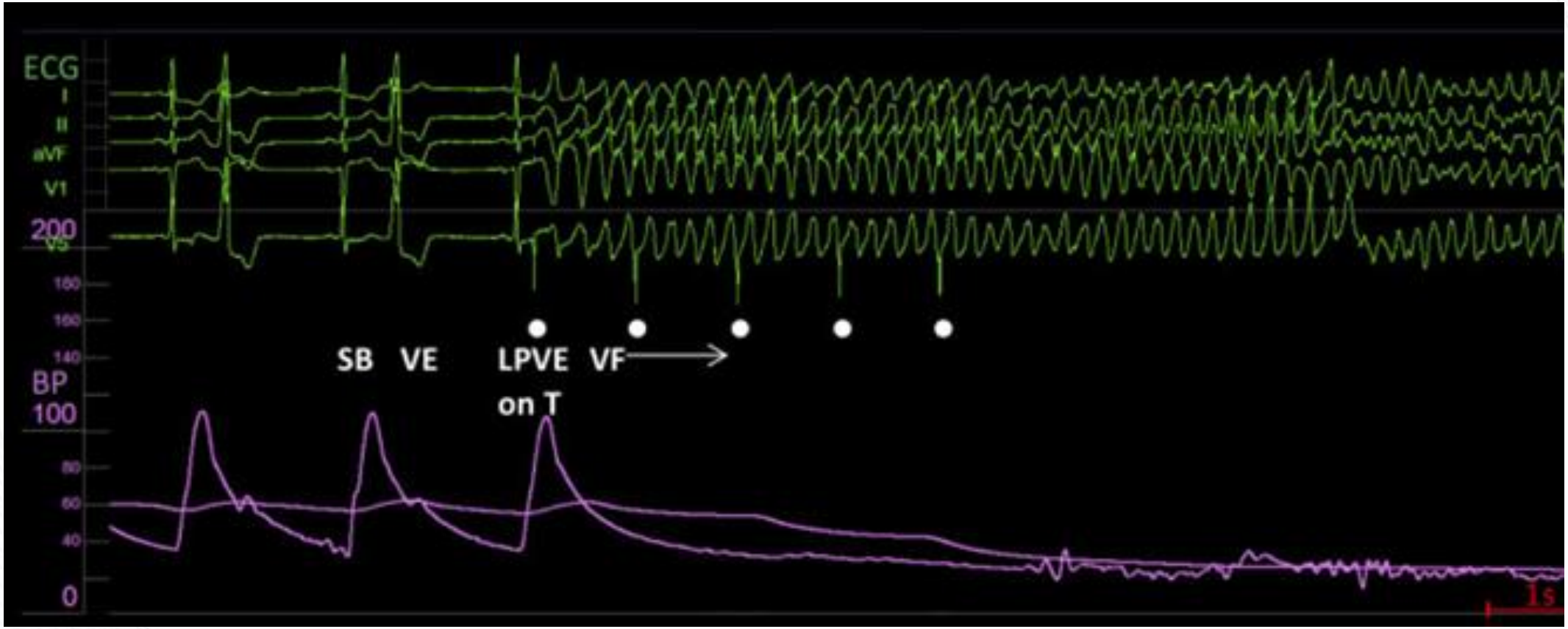
***Drop in systolic blood pressure* during IVL procedure is more often observed in cases with IVL-induced ventricular capture**

	No IVL-induced capture (n=245)	IVL-induced capture (n = 171)	P-value
Pre-procedure heart rate	69.0 ± 11.9	65.9 ± 11.4	0.009
Drop in systolic BP during IVL procedure	58/237 (24.5)	**66/163 (40.5)**	**0.0007**
- Magnitude of systolic BP decrease, mmHg	23.5 ± 15.0	**18.9 ± 14.2**	0.07
Sustained ventricular arrhythmia during or immediately after IVL procedure	1 (0.4)	0 (0.0)	1.0

Hill JM, et al. J Am Card Cardiol. 2020

Potential complications of IVL

Asynchronized IVL-pulsing may cause ventricular fibrillation in the presence of IVL-pulse induced ventricular ectopy on the T wave



McGarvey M, et al. EHJ case rep. 2020

Factors for worse outcomes after IVL

Several factors including bifurcation and prior MI should be incorporated into the decision regarding patient selection and procedural planning for IVL treatment

TABLE 5 Independent Predictors of 30-Day MACE and Procedural Success

	OR (95% CI)	p Value
30-day MACE		
Bifurcation lesion	2.41 (1.27-4.54)	0.006
Prior MI	2.06 (1.01-4.06)	0.040
Lesion length per 10 mm	1.31 (1.00-1.69)	0.049
Procedural success*		
Bifurcation lesion	0.47 (0.25-0.87)	0.015
Prior MI	0.45 (0.24-0.88)	0.016

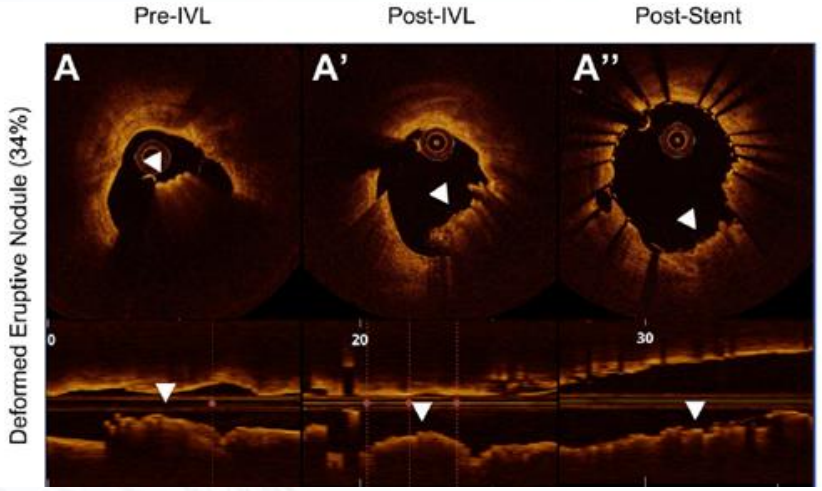
Kareiakes DJ, et al. J Am Coll Cardiol Intv. 2021

IVL for eccentric calcification

*Approximately 1/3 of **calcified protrusion are undeformable** by IVL*

Eruptive nodule (N=16)

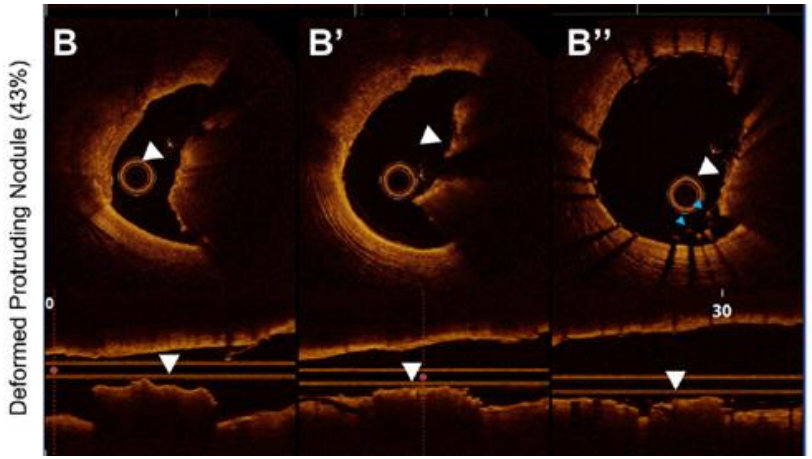
Deformable: 100%

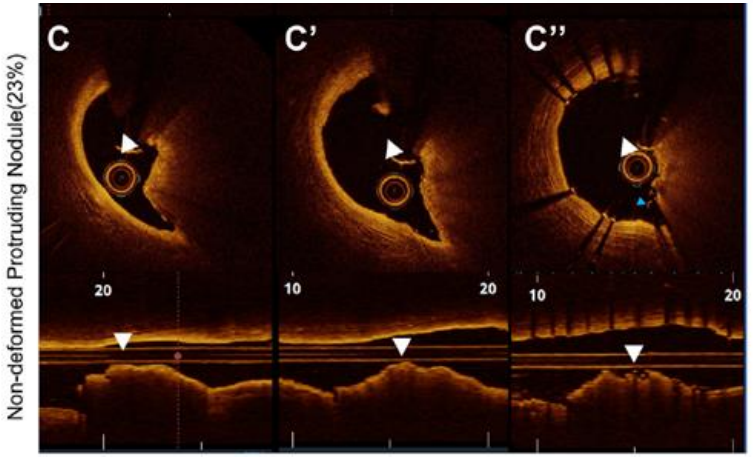


Calcified protrusion (N=31)

Deformable: 65%

Undeformable: 35%





Ali ZA, et al. J Am Coll Cardiol Intv. 2023

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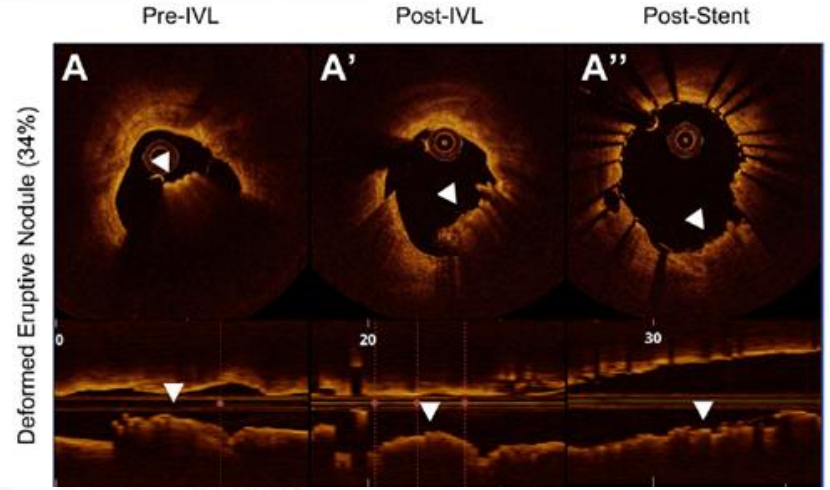
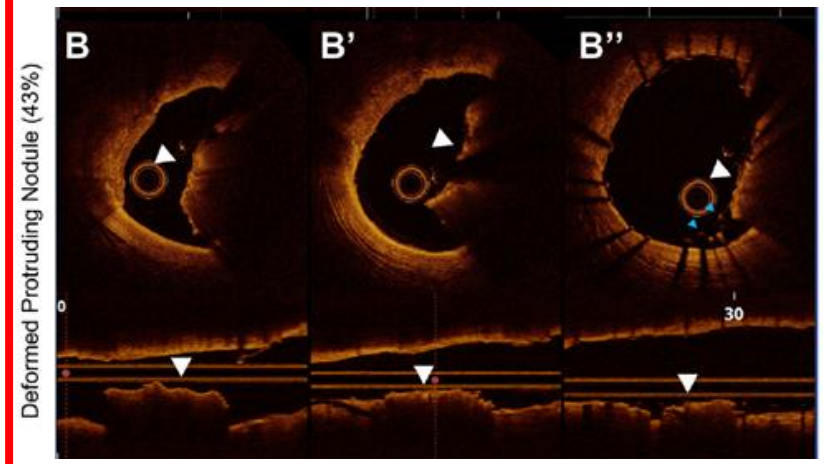
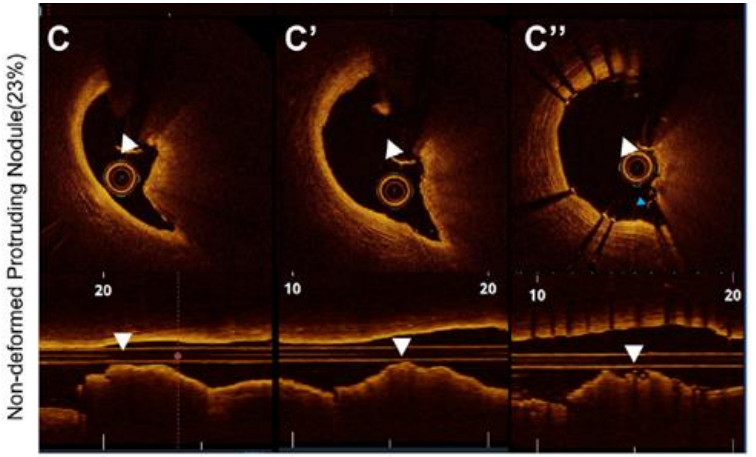


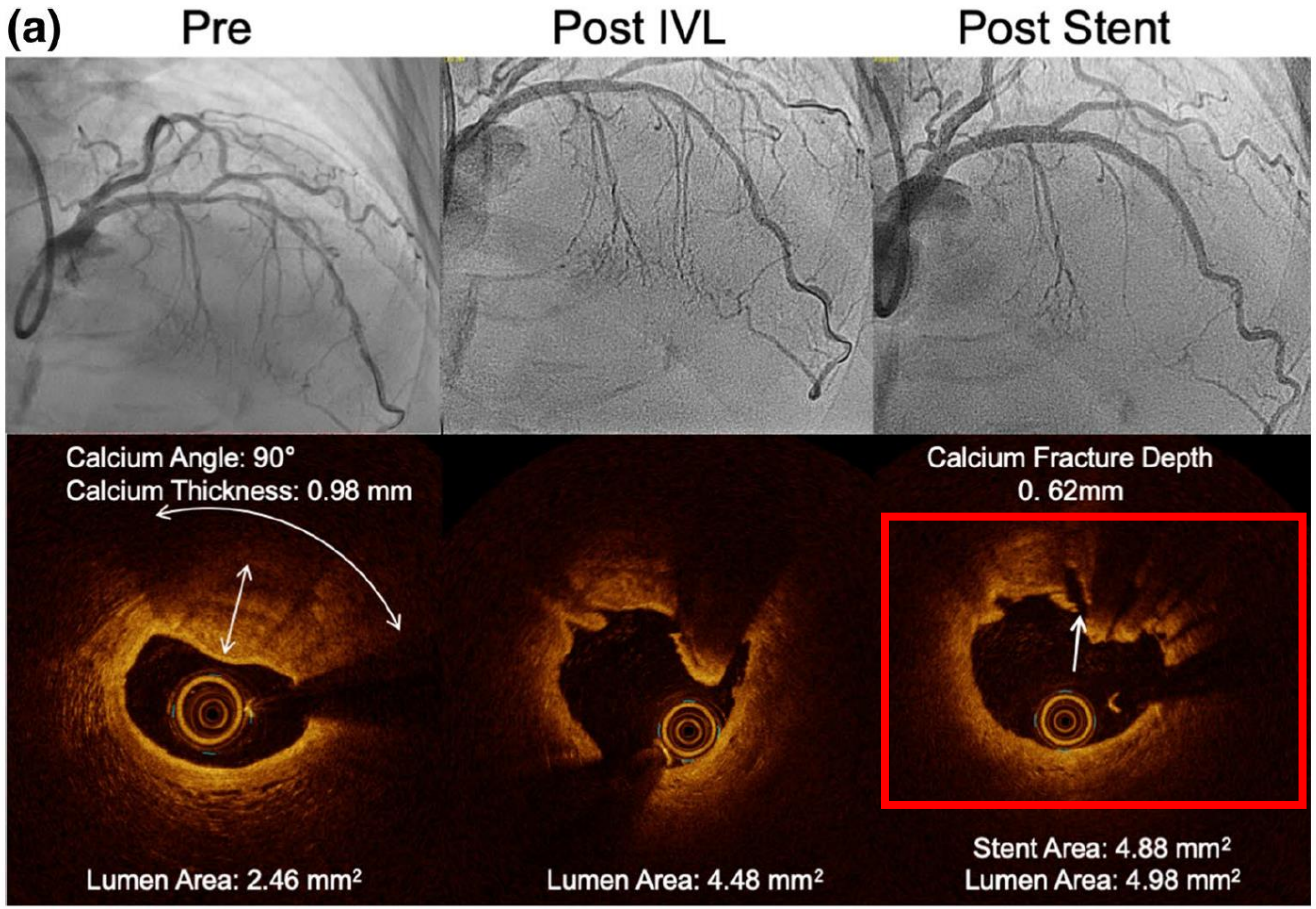


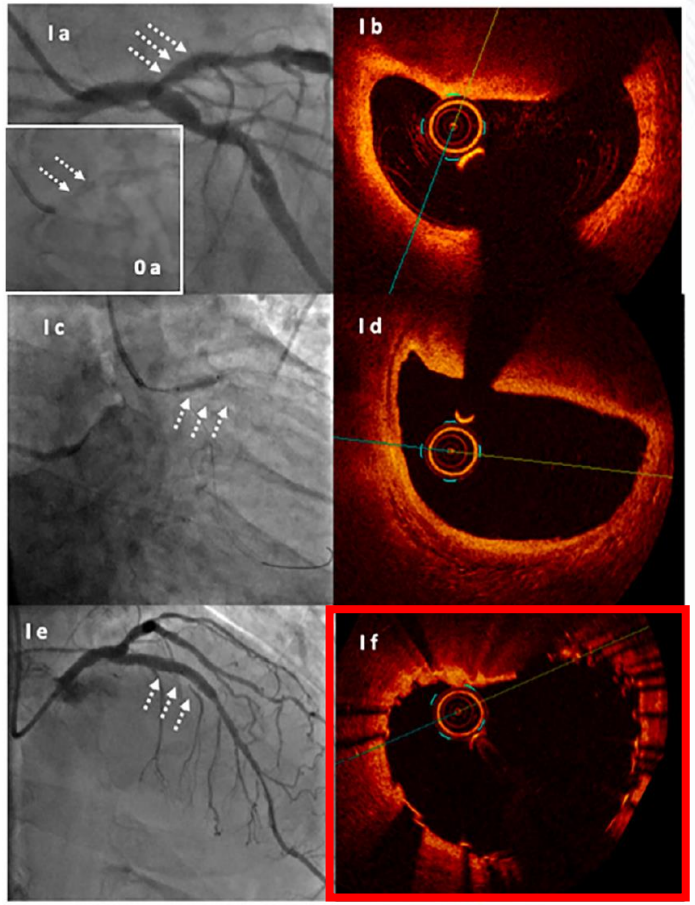


Ali ZA, et al. J Am Coll Cardiol Intv. 2023

IVL for eccentric calcification

Symmetric luminal expansion may be difficult in eccentric calcification



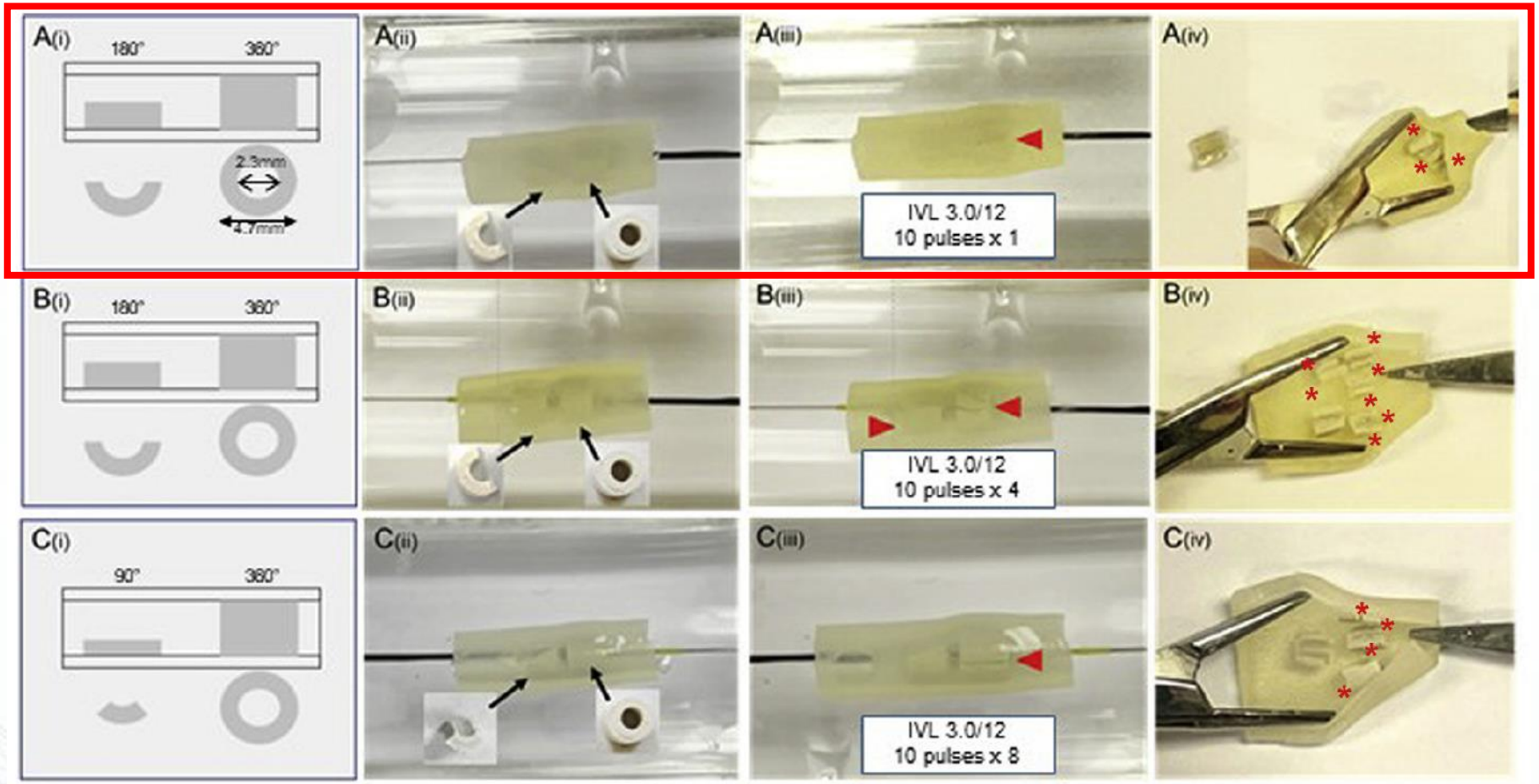


Blachutzik F, et al. Clin Res Cardiol. 2021

Mattesini A, et al. Cardiovasc Rev Med. 2020

IVL for eccentric calcification

IVL efficacy may reduce in eccentric calcification



Frankie Tam CC, et al. JACC translational. 2021

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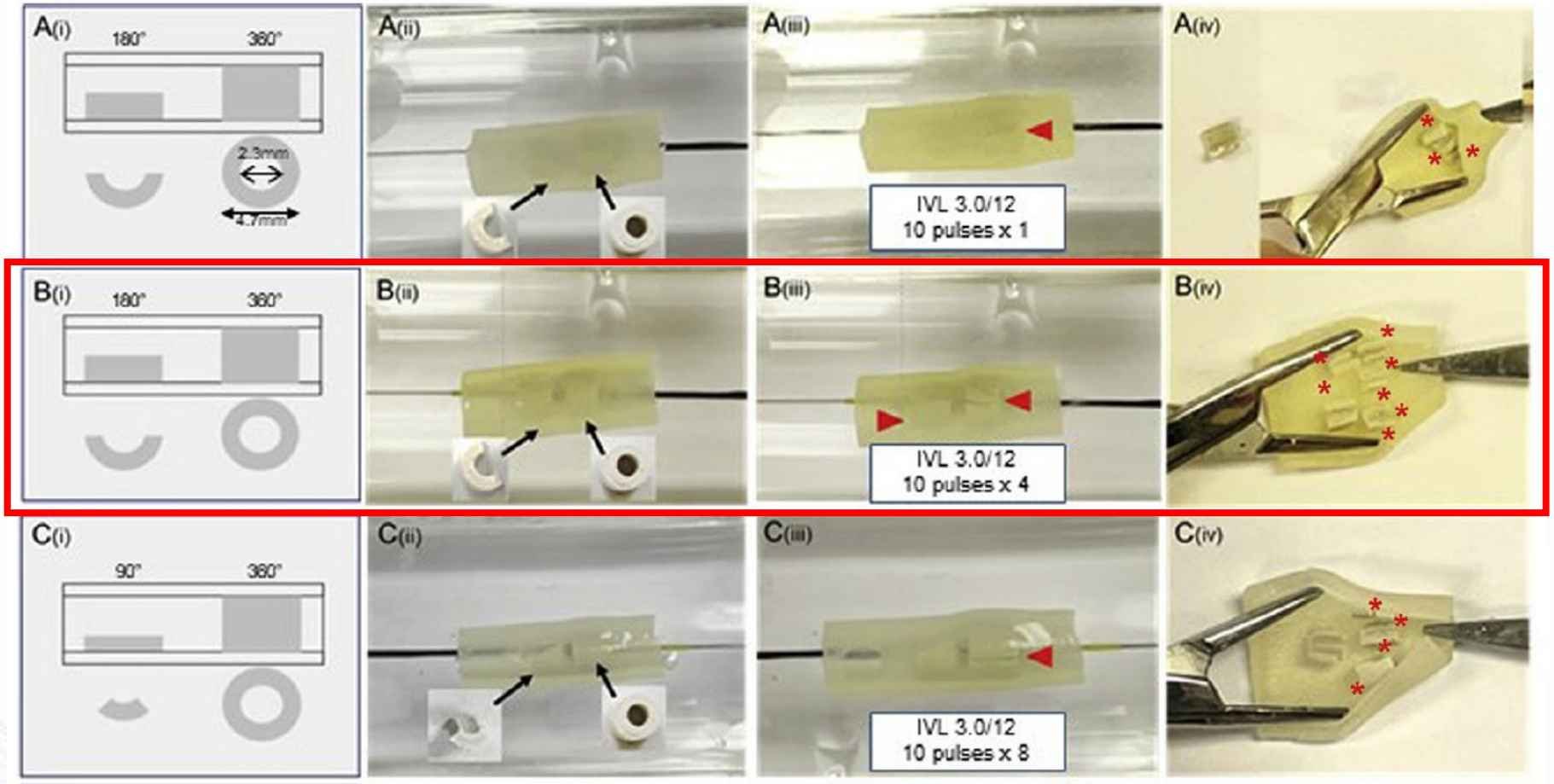

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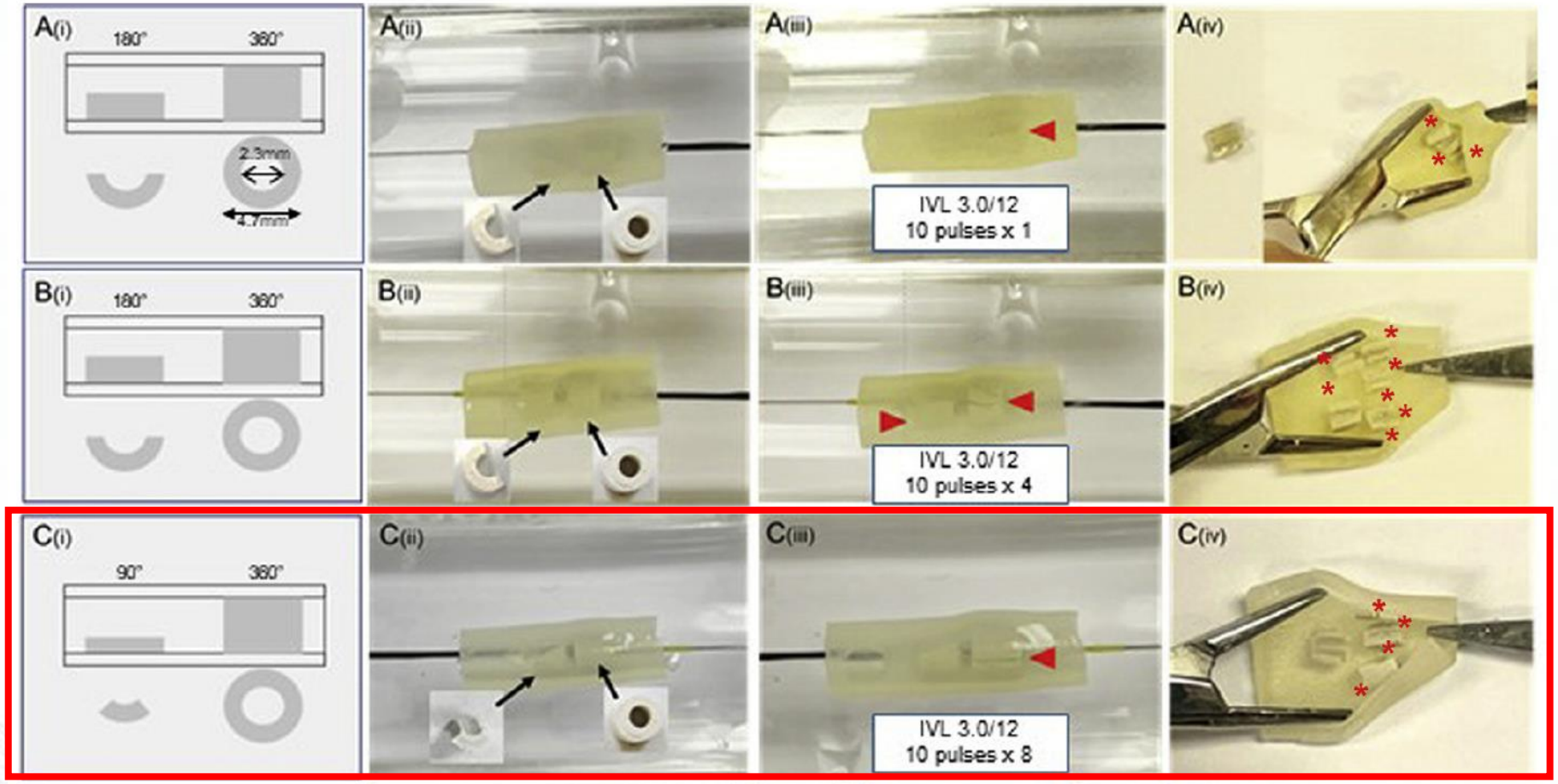

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Conclusion

- Intravascular lithotripsy (IVL) is a safe and ease-of-use tool with high procedural success rate and low incidence of MACE.
- Forceful manipulation, vessel tortuosity, protruded calcification and high-pressure post-dilatation may cause extended dissection and perforation.
- Transient reduction of blood pressure and ventricular fibrillation may occur caused by ‘shocktopics’.
- Careful consideration of IVL use is required for bifurcation lesion, eccentric calcification and patients with prior history of myocardial infarction.