Cómo lidiar con lesiones de alto contenido trombótico

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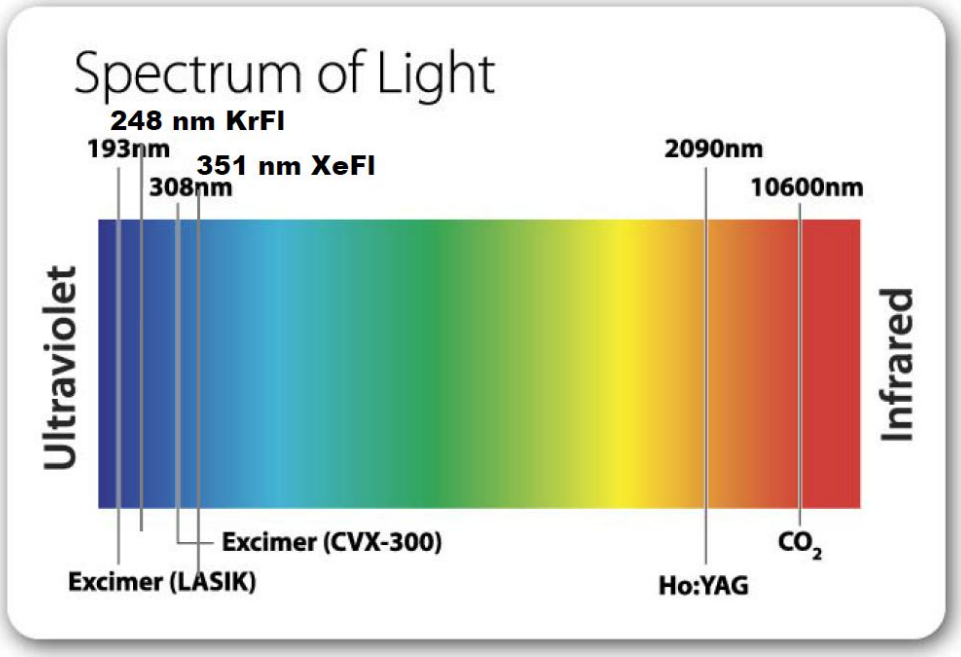
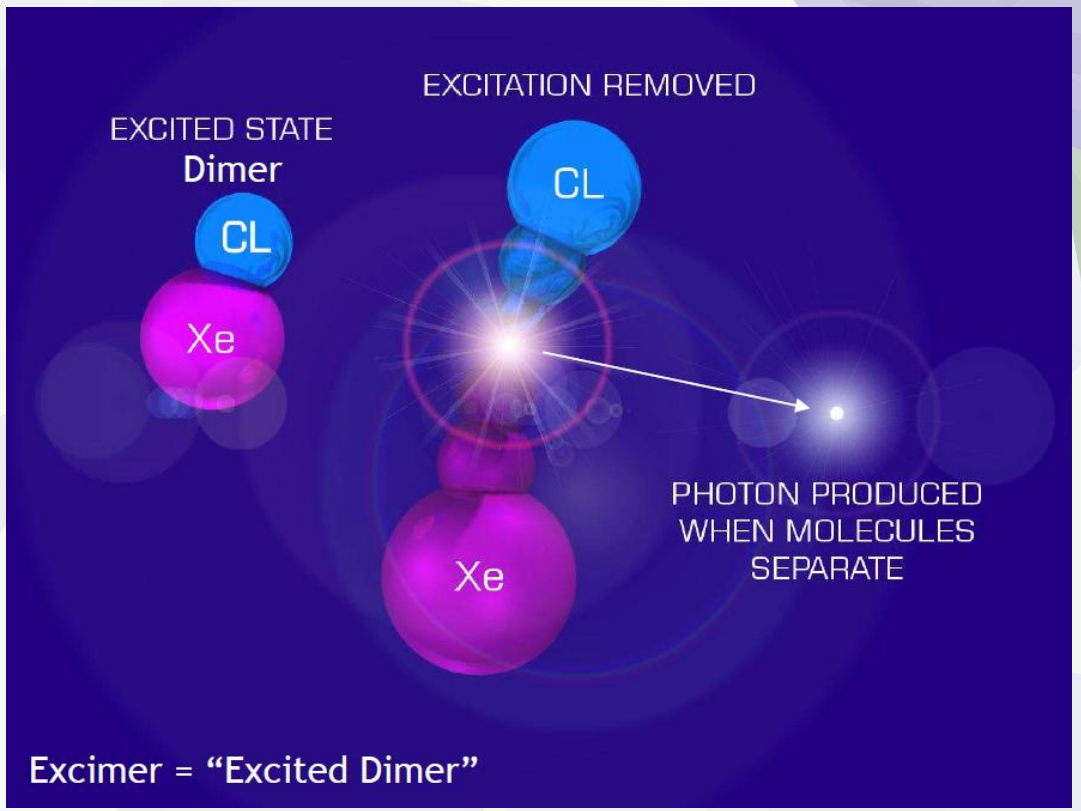
ELCA

Lasers and the Light Spectrum

Ultraviolet vs. Infrared





Longitud de onda: 308 nm

Catheter monorail
(0.9-1.4-1.7-2 mm)

Compatible con cualquier guía

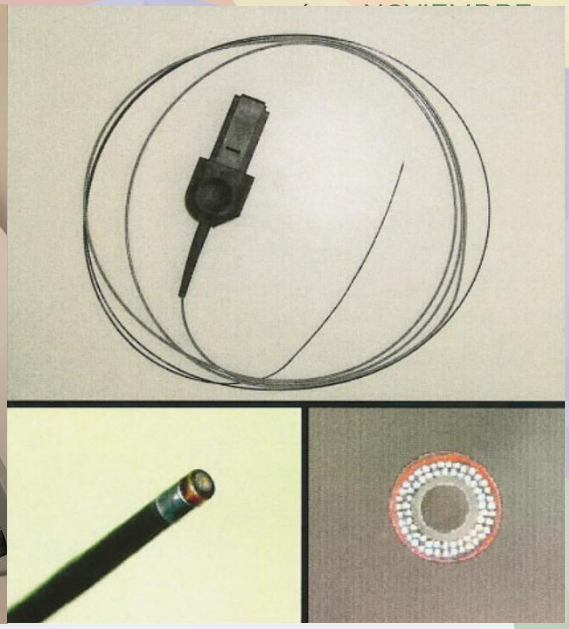
Frecuencia: 25-80 Hz

Energía: 40-80 mj/mm2

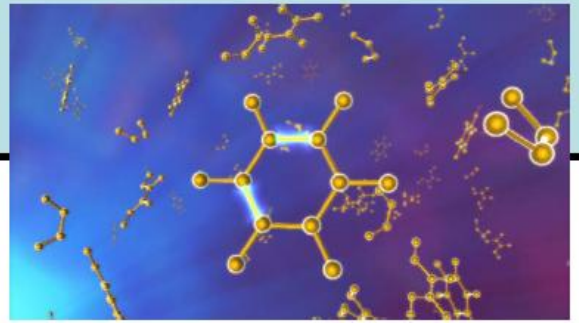
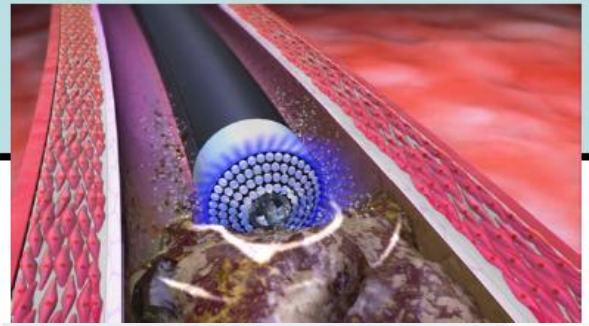
Goteo (serum): 2-3 ml/s

Avance: 0.5-1 mm/s (laser penetración: 35-50 micras)

10 s láser on-5 s láser off



PHILIPS

❶ Photochemical	❷ Photothermal	❸ Photomechanical
Breaking molecular bonds	**Producing thermal energy**	**Creating kinetic energy**
		

Modificación de la placa subyacente: partículas < 10 micras

Absorción de partículas por el sistema reticuloendotelial

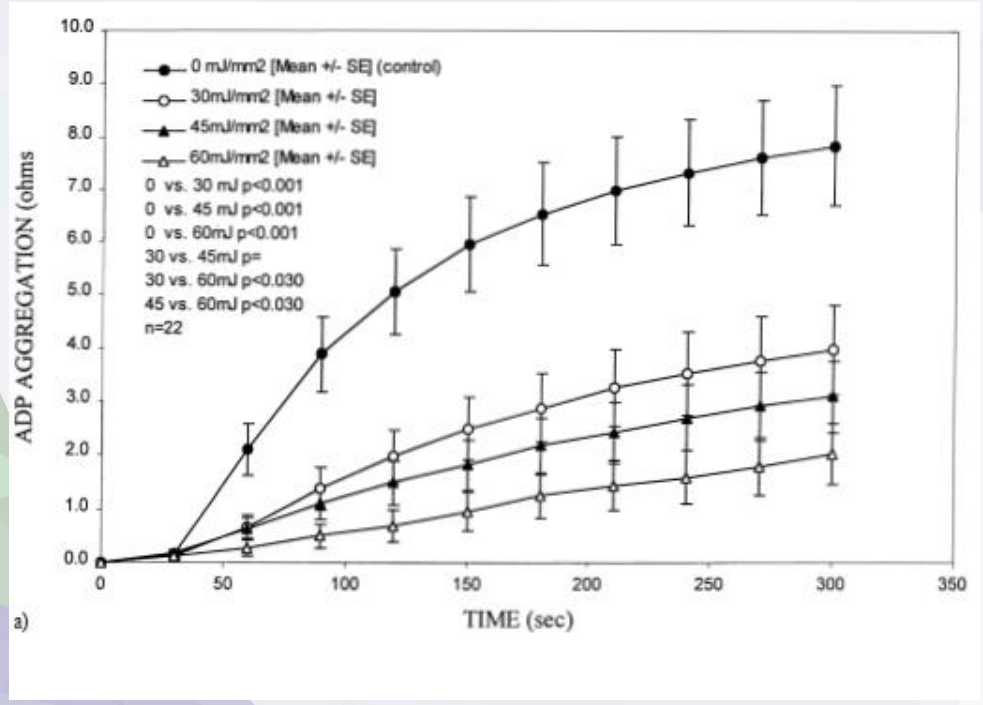
Vaporización de trombo

© 2001 Schattauer GmbH, Stuttgart Thromb Haemost 2001; 86: 1087–93

Alterations of Platelet Aggregation Kinetics with Ultraviolet Laser Emission: The "Stunned Platelet" Phenomenon

On Topaz[1], Anthony J. Minisi[1], Nelson L. Bernardo[1], Richard A. McPherson[2], Erika Martin[3], Sheryl L. Carr[3], Marcus E. Carr, Jr.[3]

Coagulation Special Studies Laboratory/[3]Division of Hematology/Oncology, Interventional Cardiovascular Laboratories, [1]Division of Cardiology, [2]Department of Pathology, McGuire VA Medical Center and Medical College of Virginia Hospitals, Virginia Commonwealth University, Richmond, Virginia, USA



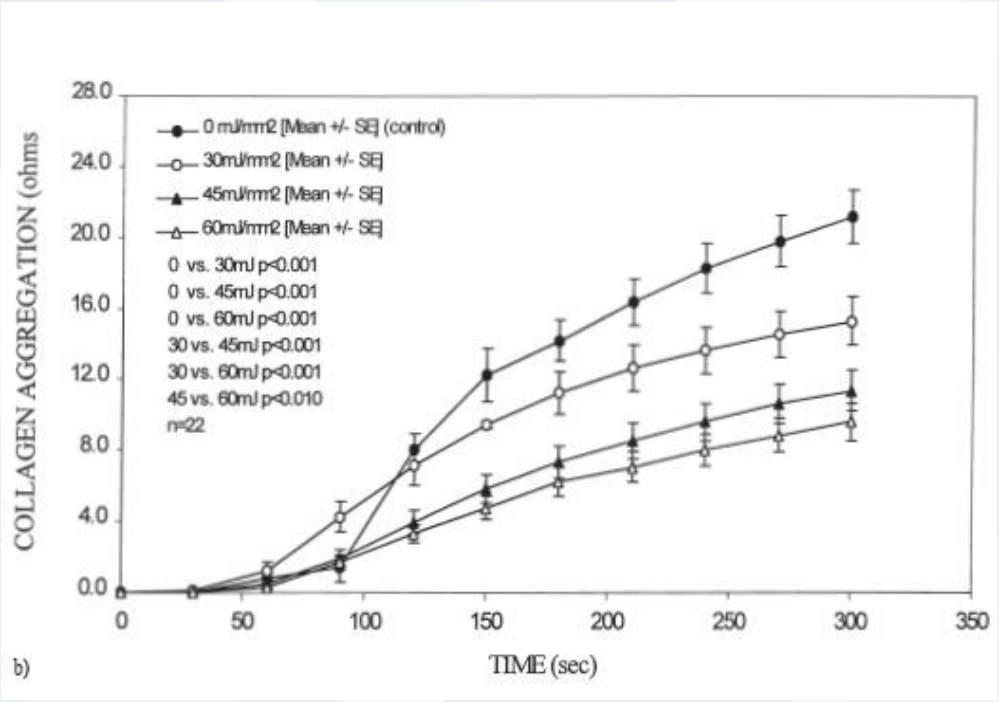


Fig. 1 Kinetics of ADP induced aggregation in whole blood exposed to increasing amounts of excimer laser energy. Platelets in blood not exposed to laser energy (●) aggregated more completely (higher Ohms) than those from blood exposed to increasing levels of laser energy (Δ, 60 mJ/mm²). ADP induced aggregation for platelets exposed to 60 mJ was significantly lower than for non-exposed blood ($p < 0.000003$). The degree of suppression from baseline (non-exposed) was statistically significant ($p < 0.003$) for each level of exposure

Interacción entre rayos ultravioleta (308 nm) y plaquetas altera la cinética de la agregación plaquetaria
(*aturdimiento plaquetario*)

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 APRIL 9, 2015 VOL. 372 NO. 15

Randomized Trial of Primary PCI with or without Routine Manual Thrombectomy

S.S. Jolly, J.A. Cairns, S. Yusuf, B. Meeks, J. Pogue, M.J. Rokoss, S. Kedev, L. Thabane, G. Stankovic, R. Moreno, A. Gershlick, S. Chowdhary, S. Lavi, K. Niemelä, P.G. Steg, I. Bernat, Y. Xu, W.J. Cantor, C.B. Overgaard, C.K. Naber, A.N. Cheema, R.C. Welsh, O.F. Bertrand, A. Avezum, R. Bhindi, S. Pancholy, S.V. Rao, M.K. Natarajan, J.M. ten Berg, O. Shestakovska, P. Gao, P. Widimsky, and V. Džavík, for the TOTAL Investigators*

Cruce exitoso de catáter de tromboaspiración en pirmer intent: 82.5%

En 5.9% después de dilatación con balóno

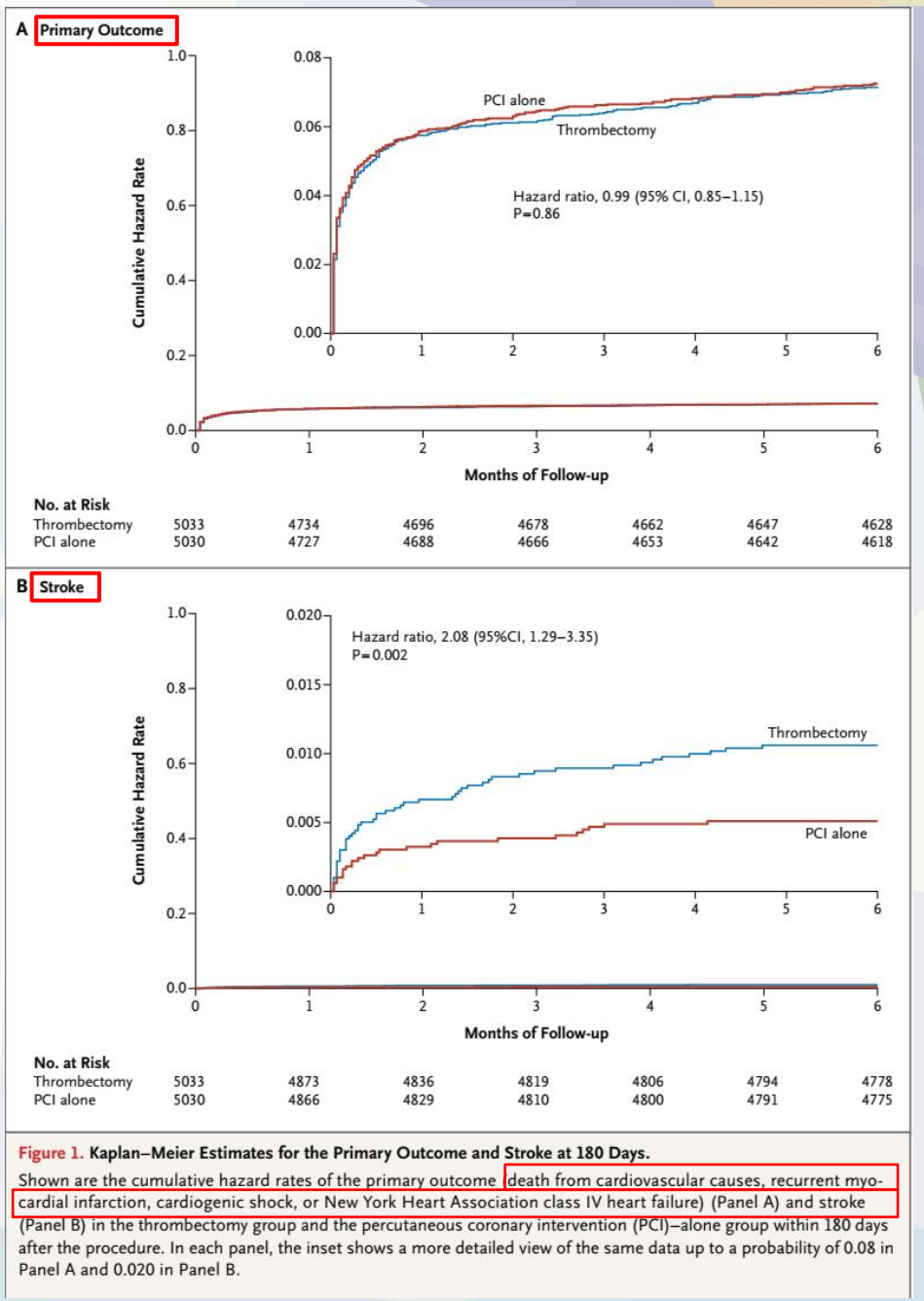


Figure 1. Kaplan–Meier Estimates for the Primary Outcome and Stroke at 180 Days.

Shown are the cumulative hazard rates of the primary outcome (death from cardiovascular causes, recurrent myocardial infarction, cardiogenic shock, or New York Heart Association class IV heart failure) (Panel A) and stroke (Panel B) in the thrombectomy group and the percutaneous coronary intervention (PCI)–alone group within 180 days after the procedure. In each panel, the inset shows a more detailed view of the same data up to a probability of 0.08 in Panel A and 0.020 in Panel B.

Circulation

CLINICAL PRACTICE GUIDELINES

2025 ACC/AHA/ACEP/NAEMSP/SCAI Guideline for the Management of Patients With Acute Coronary Syndromes: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines

Recommendation for Use of Aspiration Thrombectomy
Referenced studies that support recommendation are summarized in the Evidence Table.

COR	LOE	Recommendation
3: No benefit	**A**	1. Among patients with STEMI undergoing PPCI, manual aspiration thrombectomy should not be performed routinely prior to PCI given lack of clinical benefit.*[1–4]

Excimer Laser Angioplasty in Acute Myocardial Infarction (The CARMEL Multicenter Trial)

On Topaz, MD, Douglas Ebersole, MD, Tony Das, MD, Edwin L. Alderman, MD, Hooman Madyoon, MD, Kishor Vora, MD, John D. Baker, MD, David Hilton, MD, and Johannes B. Dahm, MD

Patients with acute myocardial infarction (AMI) with thrombus-laden lesions constitute a revascularization challenge. Thrombus and atherosclerotic plaque absorb laser energy; thus, we studied the safety and efficacy of excimer laser in AMI. In a multicenter trial, 151 patients with AMI underwent excimer laser angioplasty. Baseline left ventricular ejection fraction was 44 ± 13%, and 13% of patients were in cardiogenic shock. A saphenous vein graft was the target vessel in 21%. Quantitative coronary angiography and statistical analysis were performed by independent core laboratories. A 95% device success, 97% angiographic success, and 91% overall procedural success rate were recorded. Maximal laser gain was achieved in lesions with extensive thrombus burden ($p < 0.03$ vs small burden). Thrombolysis In Myocardial Infarction (TIMI) trial flow increased significantly by laser: 1.2 ± 1.1 to 2.8 ± 0.5 ($p < 0.001$), reaching a final 3.0 ± 0.2 ($p < 0.001$ vs baseline). Minimal luminal diameter increased by laser from 0.5 ± 0.5 to 1.6 ± 0.5 mm (mean ± SD, $p < 0.001$), followed by 2.7 ± 0.6 mm after stenting ($p < 0.001$ vs baseline and vs after laser). Laser decreased target stenosis from 83 ± 17% to 52 ± 15% (mean ± SD, $p < 0.001$ vs baseline), followed by 20 ± 16% after stenting ($p < 0.001$ vs baseline and vs after laser). Six patients (4%) died, each presented with cardiogenic shock. Complications included perforation (0.6%), dissection (5% major, 3% minor), acute closure (0.6%), distal embolization (2%), and bleeding (3%). In a multivariant regression model, absence of cardiogenic shock was a significant factor affecting procedural success. Thus, in the setting of AMI, gaining maximal thrombus dissolution in lesions with extensive thrombus burden, combined with a considerable increase in minimal luminal diameter and restoration of anterograde TIMI flow, support successful debulking by excimer laser. The presence of thrombus does not adversely affect procedural success; however, cardiogenic shock remains a predictor of major adverse events during hospitalization.

(Am J Cardiol 2004;93:694–701)

(The CÁRMEL Multicenter Trial)

TABLE 1 Procedural and Angiographic Data

Lesions (n = 151)	
Vessels treated	
Left main	2 (1%)
Left anterior descending	47 (31%)
Left circumflex	20 (13%)
Right coronary artery	51 (34%)
Saphenous vein graft	31 (21%)
Lesion morphology	
Length (mm)	23 ± 16
Total occlusion	56 (37%)
Subtotal occlusion	51 (34%)
Eccentric	62 (53%)
De novo	137 (91%)
Restenotic	4 (2%)
In-stent restenosis	10 (7%)
TIMI thrombus grading scale	
Grade 0	11 (7%)
Grade 1	14 (9%)
Grade 2	28 (19%)
Grade 3	35 (23%)
Grade 4	63 (42%)
Largest laser catheter used	
0.9 mm	13 (9%)
1.4 mm	38 (25%)
1.7 mm	65 (43%)
2.0 mm	35 (23%)
Mean no. of laser catheters used	1.1
Mean no. of laser pulses	1,764 ± 1,919
Adjunct PTCA	149 (99%)
Stents	139 (92%)
Glycoprotein IIb/IIIa receptor antagonists	78 (52%)
% Angiographic stenosis	
Baseline	95% ± 6%
Postlaser	48% ± 23%*
Final	3% ± 9%*
TIMI flow	
Baseline	1.2 ± 1.1
Postlaser	2.8 ± 0.5*
Final	3.0 ± 0.2*
Laser success	143 (95%)
Angiographic success	146 (97%)
Procedural success	138 (91%)

*p <0.001 versus baseline.
PTCA = percutaneous transluminal coronary angioplasty.

TABLE 3 Debulking per TIMI Thrombus Grading Scale (N = 151 patients)

	TIMI Thrombus Grading Scale				
	0 No Thrombus (n = 11)	1 Small Thrombus (n = 14)	2 Medium Thrombus (n = 28)	3 Large Thrombus (n = 35)	4 Extensive Thrombus (n = 63)
MLD					
Baseline (mm)	0.87 ± 0.69	0.72 ± 0.43	0.65 ± 0.45	0.59 ± 0.49	0.37 ± 0.49
Postlaser	1.74 ± 0.46	1.48 ± 0.49	1.51 ± 0.51	1.50 ± 0.41	1.62 ± 0.62
Laser acute gain	0.90 ± 0.63	0.76 ± 0.52*	0.84 ± 0.60	0.94 ± 0.48	1.21 ± 0.72
Final	2.97 ± 0.60	2.54 ± 0.55	2.47 ± 0.62	2.62 ± 0.55	2.76 ± 0.62
%DS					
Baseline	74 ± 21%	76 ± 16%	77 ± 16%	82 ± 16%	89 ± 15%
Postlaser	47 ± 13%	51 ± 11%	52 ± 15%	51 ± 13%	53 ± 17%
Laser acute gain	27 ± 18%	25 ± 15%	25 ± 19%	31 ± 16%	36 ± 20%
Final	16 ± 17%	15 ± 13%	22 ± 14%	16 ± 17%	22 ± 16%

*p <0.03 versus extensive thrombus.
Abbreviations as in Table 2.

TABLE 4 Complications

Death	6 (4%)
Emergency bypass surgery	0
Neurologic damage	0
Perforation	1 (0.6%)
Guidewire-induced	0
Laser-induced	0
Balloon-induced	1 (0.6%)
Dissection	12 (8%)
Major (NHLBI type C or D)	7 (5%)
Guidewire-induced	2 (1.4%)
Laser-induced	4 (3%)
Balloon-induced	1 (0.6%)
Minor (NHLBI type B)	5 (3%)
Guidewire-induced	0
Laser-induced	2 (1.3%)
Balloon-induced	3 (2%)
Acute closure	1 (0.6%)
Distal embolization	3 (2%)
Laser-induced	1 (0.6%)
Stent-induced	1 (0.6%)
Balloon-induced	1 (0.6%)
No reflow	4 (3%)
Laser-induced	1 (0.6%)
Stent-induced	2 (1.4%)
TEC-induced	1 (0.6%)
Late thrombosis	2 (1.4%)
Bleeding (groin, 3; GI, 1)	4 (3%)

GI = gastrointestinal; NHLBI = National Heart, Lung, and Blood Institute; TEC = transluminal extraction catheter.

Circulation Journal
Official Journal of the Japanese Circulation Society
http://www.j-circ.or.jp

ORIGINAL ARTICLE
Cardiovascular Intervention

Vaporizing Thrombus With Excimer Laser Before Coronary Stenting Improves Myocardial Reperfusion in Acute Coronary Syndrome

Daisuke Shishikura, MD; Satoru Otsuji, MD, PhD; Shin Takiuchi, MD, PhD; Atsushi Fukumoto, MD; Katsuaki Asano, MD, PhD; Masashi Ikushima, MD, PhD; Tokuki Yasuda, MD; Katsuyuki Hasegawa, MD; Toshikazu Kashiyama, MD; Masanori Yabuki, MD, PhD; Toshiaki Hanafusa, MD, PhD; Yorihiko Higashino, MD

Table 1. Patient Clinical Characteristics

Characteristics	ELCA (n=50)	ASP (n=48)	P-value
Diagnosis			
STEMI	40 (80.0)	41 (85.4)	
NSTEMI	2 (4.0)	4 (8.3)	
UAP	1 (2.0)	0 (0)	
RMI	7 (14.0)	3 (6.3)	
Age (years)	67.0±9.8	66.1±12.9	NS
Male	41 (82.0)	36 (75.0)	NS
Hypertension	29 (58.0)	26 (54.2)	NS
Diabetes mellitus	16 (32.0)	15 (31.3)	NS
Dyslipidemia	27 (54.0)	27 (56.3)	NS
Smoking	24 (48.0)	27 (56.3)	NS
Previous MI	6 (12.0)	2 (4.2)	NS
Previous PTCA	6 (12.0)	2 (4.2)	NS
Previous CABG	0 (0)	0 (0)	NS
LVEF before PTCA (%)	52.8±9.2	55.4±9.4	NS
ΔWMSI at 2 weeks later	0.2±0.1	0.2±0.2	NS
Door-to-balloon time (min)	50.9±15.0	44.1±16.9	0.04
Peak CK (IU/L)	2,208±1,742	2,744±2,706	NS
Peak CK-MB (IU/L)	186±167	199±224	NS

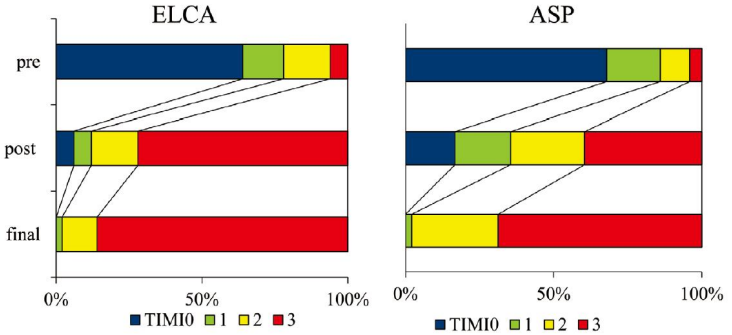


Figure 2. Thrombolysis In Myocardial Infarction (TIMI) flow grade before and after the procedure. The proportion of lesions with TIMI grade 3 flow was significantly higher in the excimer laser coronary angioplasty (ELCA) group after ELCA treatment and at the final angiogram than in the manual aspiration (ASP) group (86.0% vs. 68.8%, P=0.04).

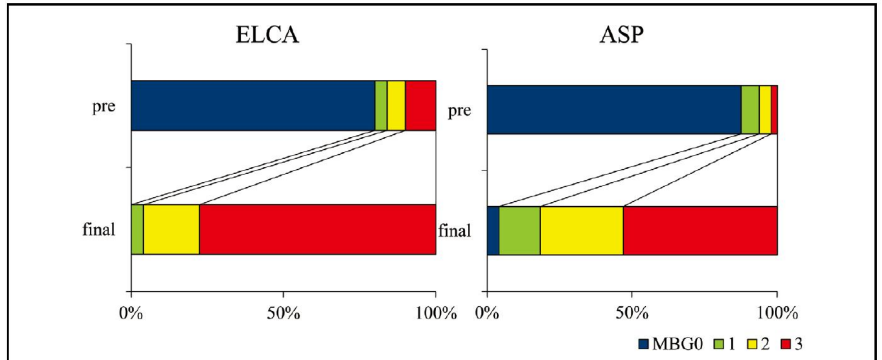


Figure 3. Myocardial blush grade (MBG) at the final angiogram. The proportion of lesions with an MBG of 3 was significantly higher in the excimer laser coronary angioplasty (ELCA) group at the final angiogram than in the manual aspiration (ASP) group (76.0% vs. 54.2%, P=0.02).

Table 4. Device Success and Procedural Complications

	ELCA (n=50)	ASP (n=48)	P-value
Device success			
Lesion crossability†	50 (96.2)	48 (82.6)	0.04
Attainment of ≥20% reduction in stenosis after procedure	44 (88)	31 (64.6)	0.01
Procedural success			
In-hospital MACE	0 (0)	5 (10.4)	0.03
TLR/TVR	0 (0)	0	NS
MI	0 (0)	0	NS
CABG	0 (0)	2 (4.2)	NS
Death	0 (0)	3 (6.3)	NS
Procedural complications			
No reflow/slow flow	1 (2.0)	3 (6.3)	NS
Distal embolism	6 (12.0)	13 (27.1)	0.05
Side-branch occlusion	1 (2.0)	0 (0)	NS
Dissection	2 (4.0)	1 (2.1)	NS

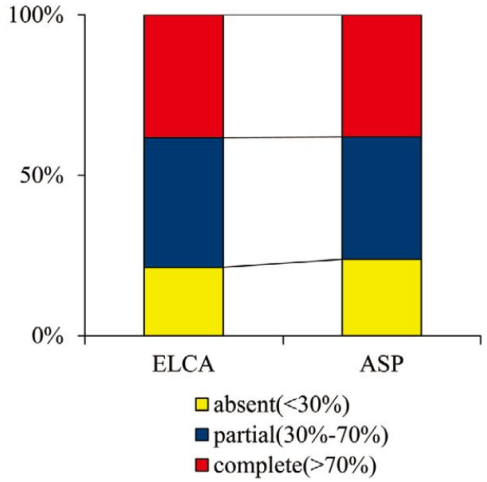
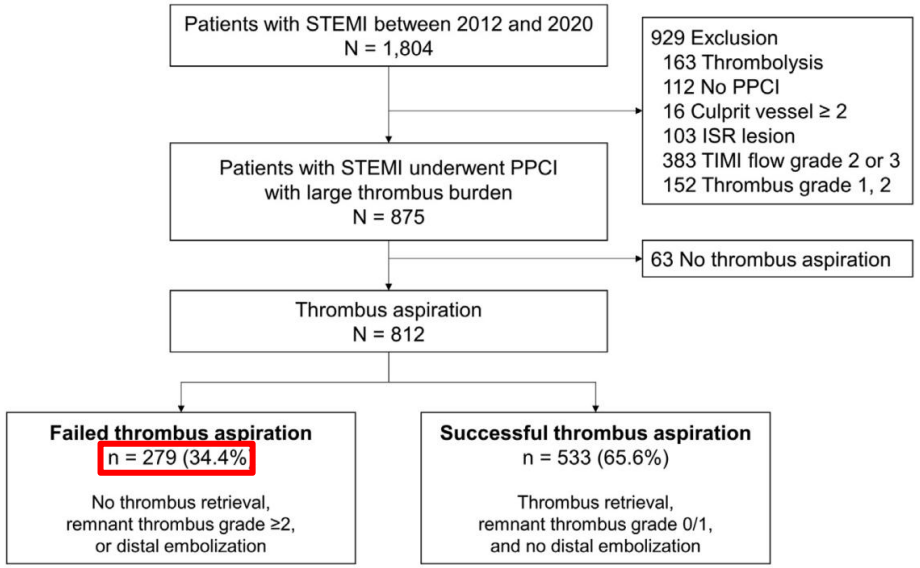


Figure 4. ST-segment elevation resolution at 30–60 min after the procedure in ST-segment elevation myocardial infarction patients only. There were no significant differences in ST-segment elevation resolution between the 2 groups (35.0% vs. 39.0%, NS). ELCA, excimer laser coronary angioplasty; ASP, aspiration.

Failed Thrombus Aspiration and Reduced Myocardial Perfusion in Patients With STEMI and Large Thrombus Burden



ISR = in-stent restenosis; PPCI = primary percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction; TIMI = Thrombolysis In Myocardial Infarction.

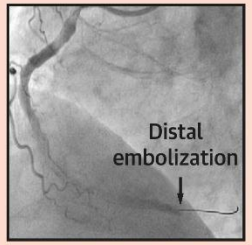
CENTRAL ILLUSTRATION: Definitions, Predictors, and Outcomes of Failed or Successful Thrombus Aspiration

Failed Thrombus Aspiration Among STEMI Patients With Large Clot Burden

Patients with STEMI undergoing PPCI with large thrombus burden (N = 812)

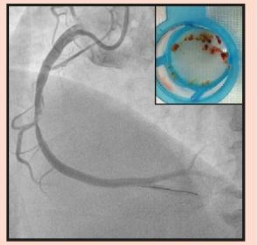
Failed TA (n = 279)

No thrombus retrieval, remnant thrombus grade ≥2, or distal embolization



Successful TA (n = 533)

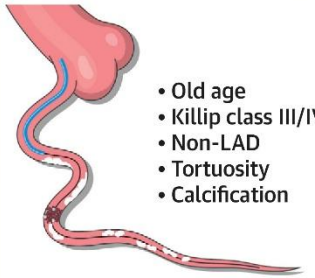
Thrombus retrieval, remnant thrombus grade 0/1, and no distal embolization



Outcome Measures

	Failed TA (n = 279)	Successful TA (n = 533)	*P* Value
Final TIMI flow grade 0-2	71 (25.4)	94 (17.6)	0.009
Myocardial blush grade 0/1	55 (19.7)	73 (13.7)	0.025
Microvascular obstruction on CMR	46/56 (82.1)	62/100 (62.0)	0.009
Cardiac death at 30 days	31 (11.1)	34 (6.4)	0.018

Predictors of TA Failure



- Old age
- Killip class III/IV
- Non-LAD
- Tortuosity
- Calcification

- Failed thrombus aspiration is associated with reduced myocardial perfusion and an unfavorable clinical outcome in patients with STEMI and large thrombus burden
- Older age, hemodynamic instability, tortuous and calcified IRA, and non-LAD as the IRA mitigate the effectiveness of manual thrombus aspiration

Jeon HS, et al. JACC Cardiovasc Interv. 2024;17(19):2216-2225.

Research Article

Laser Vaporization of Intracoronary Thrombus and Identifying Plaque Morphology in ST-Segment Elevation Myocardial Infarction as Assessed by Optical Coherence Tomography

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Academic Editor: Seif S. El-Jack

Objectives. We evaluated the thrombus-vaporizing effect of excimer laser coronary angioplasty (ELCA) in patients with ST-segment elevation myocardial infarction (STEMI) by optical coherence tomography (OCT). *Background*. Larger intracoronary thrombus elevates the risk of interventional treatment and mortality in patients with STEMI. *Methods*. A total of 92 patients with STEMI who presented within 24 hours from the onset and underwent ELCA following manual aspiration thrombectomy (MT) were analyzed. *Results*. The mean baseline thrombolysis in myocardial infarction flow grade was 0.4 ± 0.6, which subsequently improved to 2.3 ± 0.7 after MT ($p < 0.0001$) and 2.7 ± 0.5 after ELCA ($p = 0.0001$). The median residual thrombus volume after MT was 65.7 mm^3, which significantly reduced to 47.5 mm^3 after ELCA ($p < 0.0001$). Plaque rupture was identified by OCT in only 22 cases (23.9%) after MT, but was distinguishable in 36 additional cases after ELCA (total: 58 cases; 63.0%). Ruptured lesions contained a higher proportion of red thrombus than nonruptured lesions (75.9% vs. 43.3%, $p = 0.001$). Significantly larger thrombus burden after MT (69.6 mm^3 vs. 56.3 mm^3, $p < 0.05$) and greater thrombus reduction by ELCA (21.2 mm^3 vs. 11.8 mm^3, $p < 0.01$) were observed in ruptured lesions than nonruptured lesions. *Conclusions*. ELCA effectively vaporized intracoronary thrombus in patients with STEMI even after MT. Lesions with plaque rupture contained larger thrombus burden that was frequently characterized by red thrombus and more effectively reduced by ELCA.

Research Article

Laser Vaporization of Intracoronary Thrombus and Identifying Plaque Morphology in ST-Segment Elevation Myocardial Infarction as Assessed by Optical Coherence Tomography

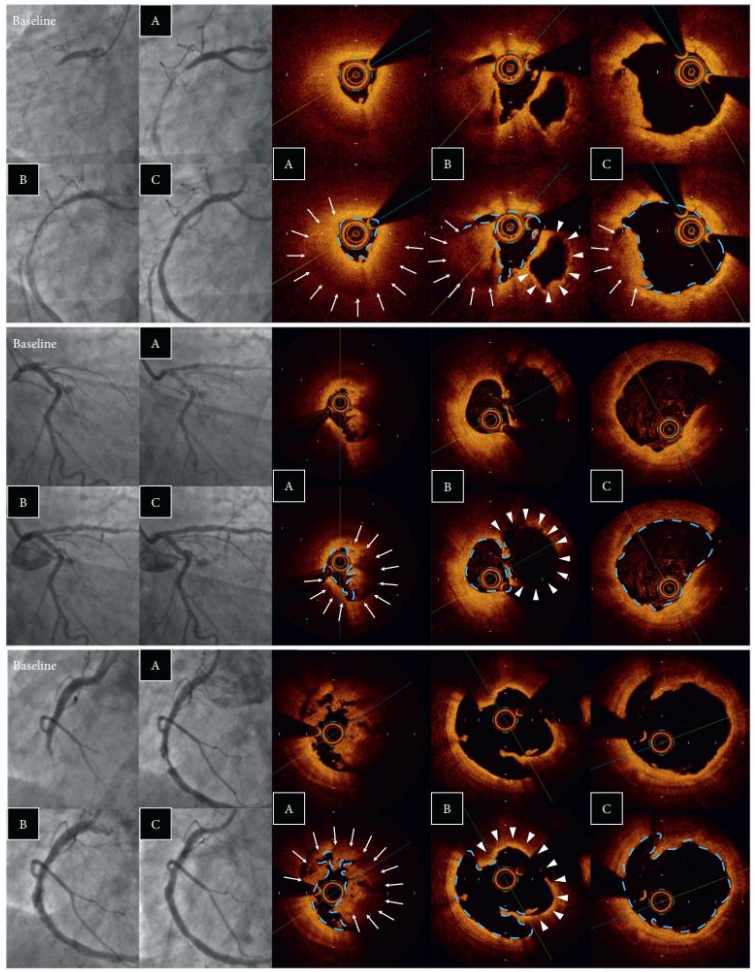


FIGURE 4: Examples of plaque rupture. Angiographic and OCT images after (A) MT, (B) ELCA, and (C) ballooning. Laser vaporization of the thrombus (arrow) enabled the identification of the ruptured cavity (arrow head). ELCA, excimer laser coronary angioplasty; MT, manual aspiration thrombectomy; and OCT, optical coherence tomography.

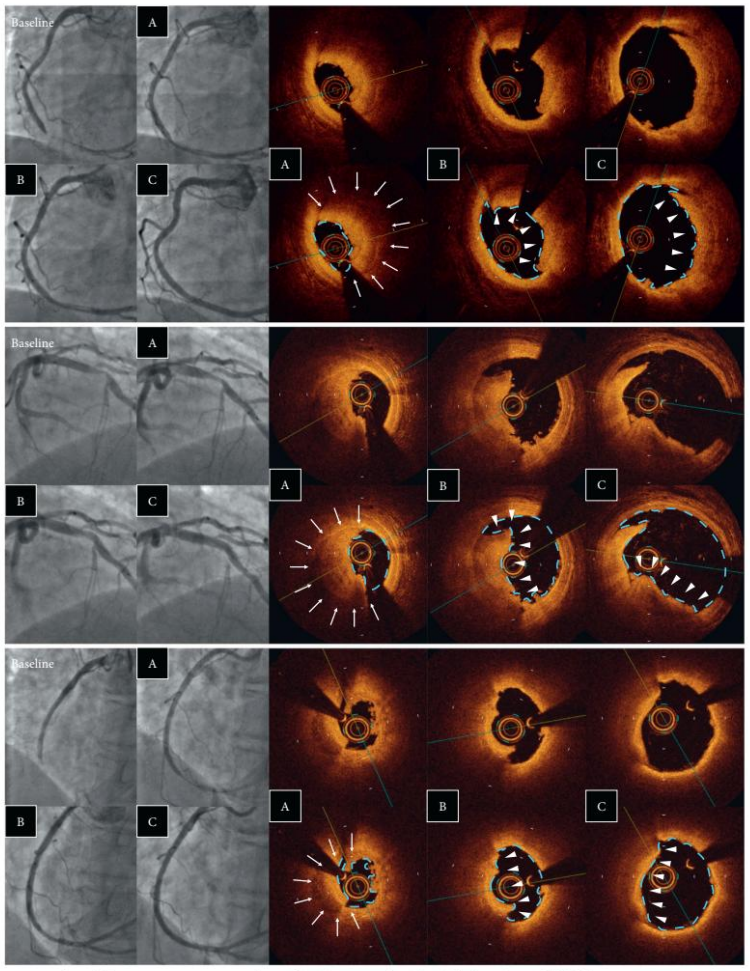


FIGURE 5: Examples of plaque erosion. Angiographic and OCT images after (A) MT, (B) ELCA, and (C) ballooning. Laser vaporization of the thrombus (arrow) clarified the identification of the attached thrombus overlying the eroded plaque (arrow head). ELCA, excimer laser coronary angioplasty; MT, manual aspiration thrombectomy; and OCT, optical coherence tomography.

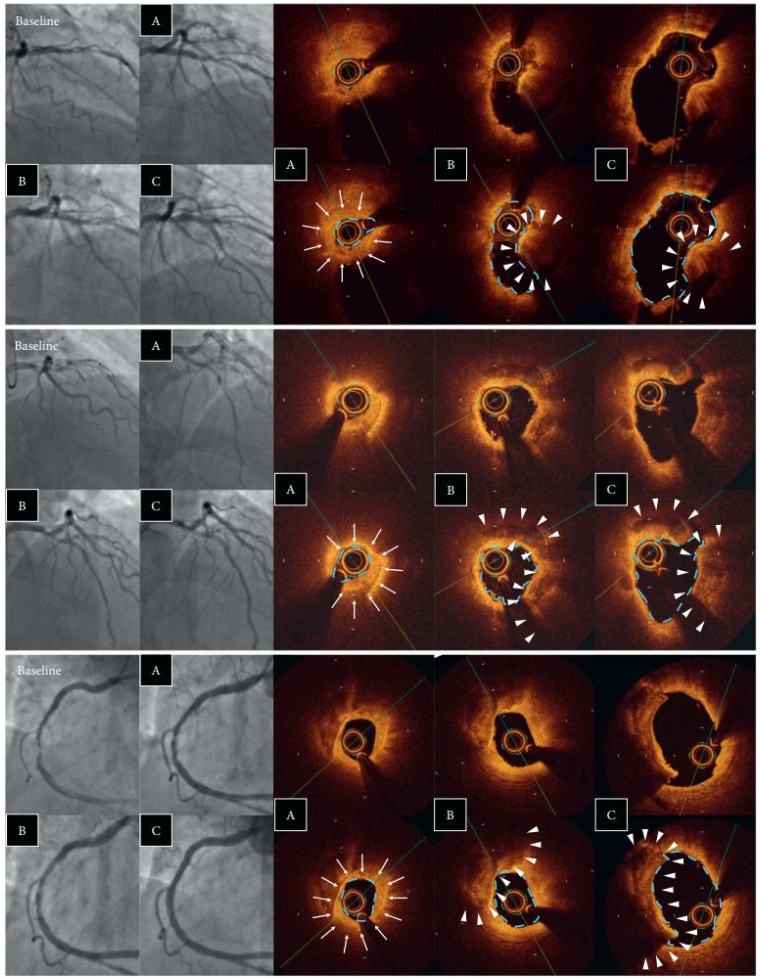


FIGURE 6: Examples of calcium nodules. Angiographic and OCT images after (A) MT, (B) ELCA, and (C) ballooning. Laser vaporization of the thrombus (arrow) clarified the identification of nodular protruding calcium (arrow head). ELCA, excimer laser coronary angioplasty; MT, manual aspiration thrombectomy; and OCT, optical coherence tomography.

Basal characteristics

N: 130

Age
61.8±11.7

Woman
18 (13.8%)

DM
18 (13.8%)

Killip

I
98 (75.4%)

II
18 (13.8%)

III
3 (2.3%)

IV
11 (8.5%)

Laser catheter (Fr)

0.9
114 (87.7%)

1.4
16 (12.3%)

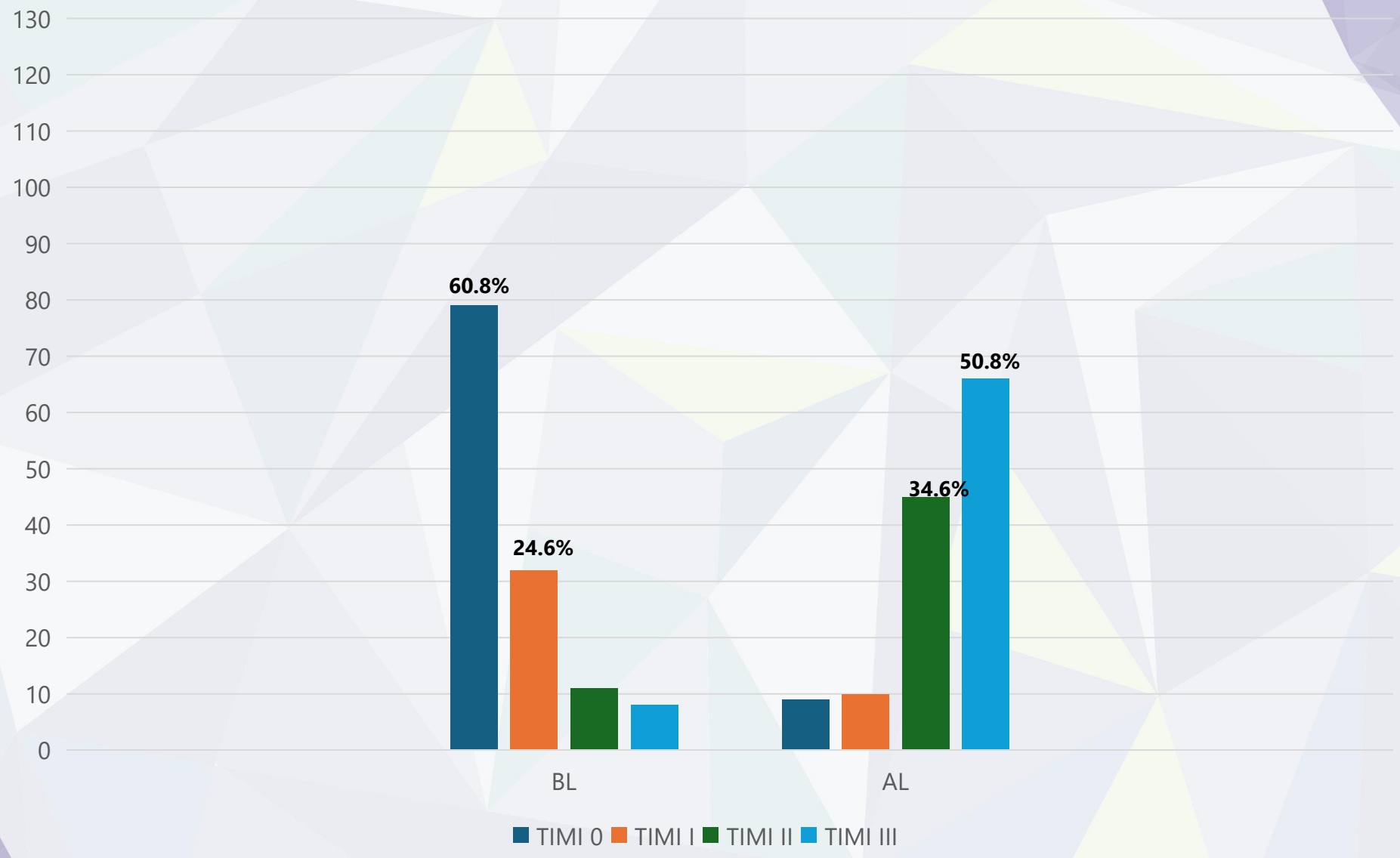
Laser initial strategy
66 (50.8%)

Laser rescue therapy

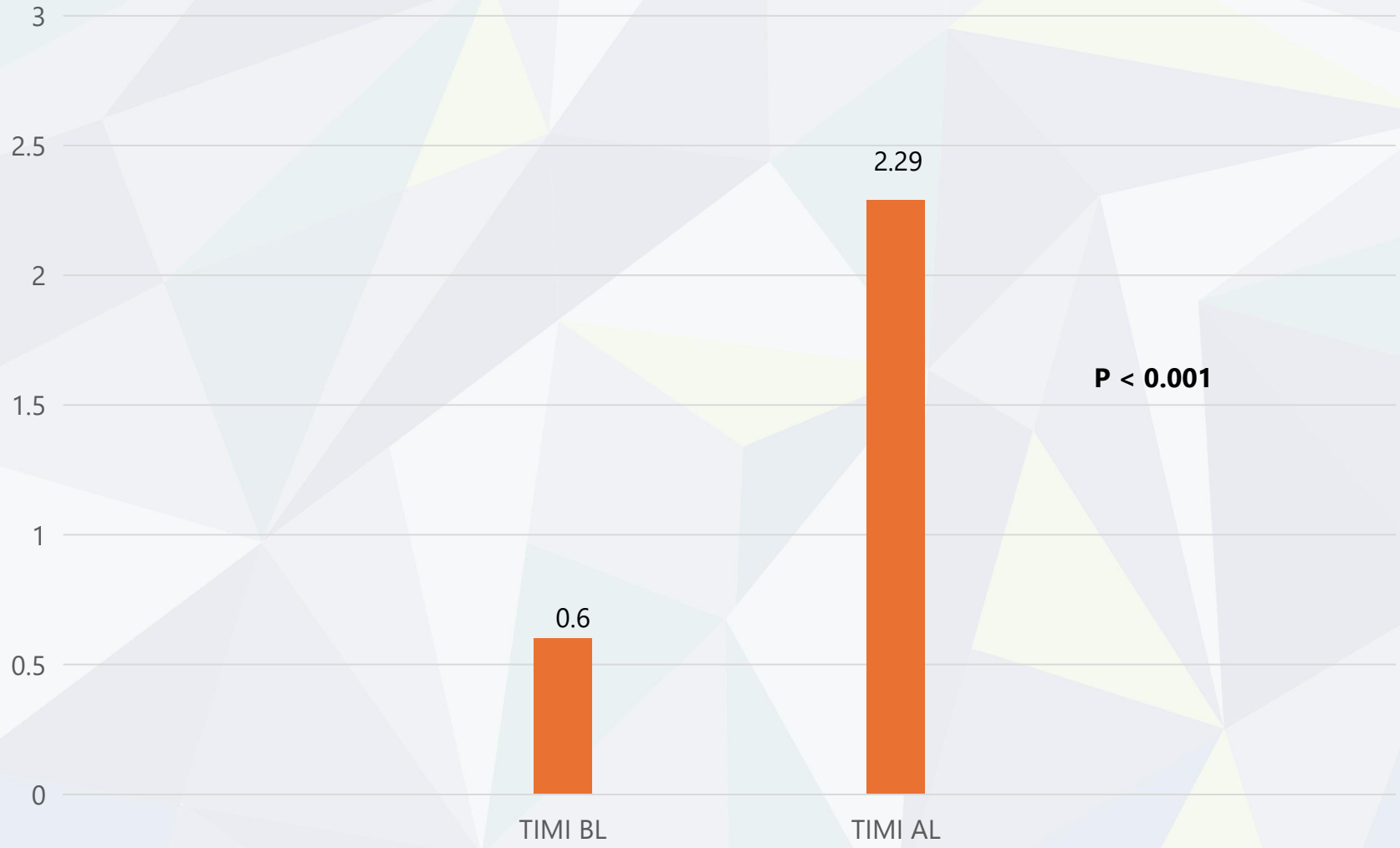
Éxito técnico: cruce completo de la lesión culpable por el catéter láser y la consecuente liberación de energía

Éxito procedimiento: (TIMI) ≥ II sin complicaciones graves (muerte, perforación coronaria o necesidad de cirugía de by-pass coronario urgente)

Flujo TIMI antes y después de láser



Flujo TIMI antes y después de láser



Technical and procedural success

Technical success
128 (98.5%)

Procedural success
124 (95.4%)

Complicactions

Death
1 (0.8)

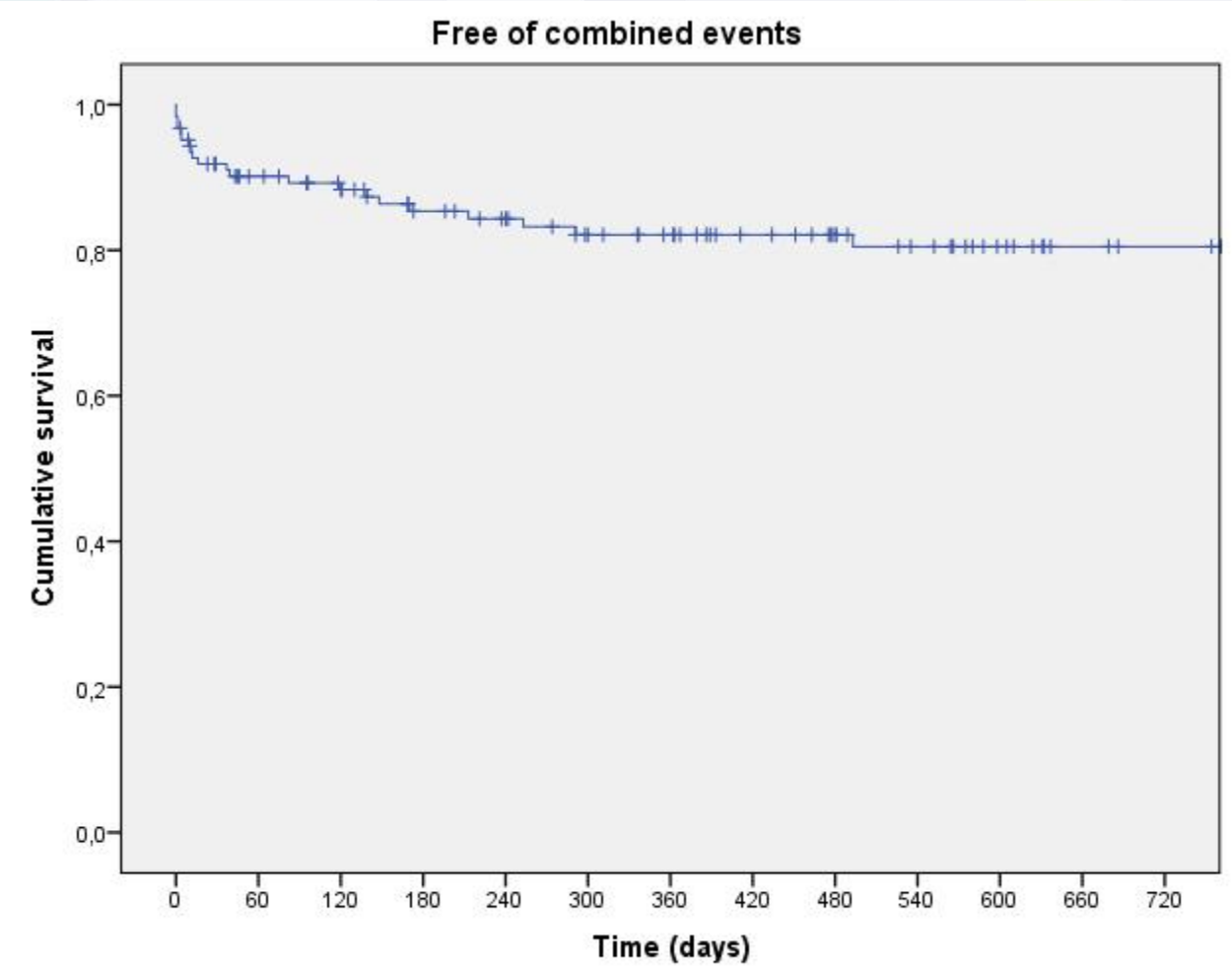
Perforation
1 (0.8)

Distal embolization
3 (2.3)

Ventricular arrhythmia
1 (0.8)

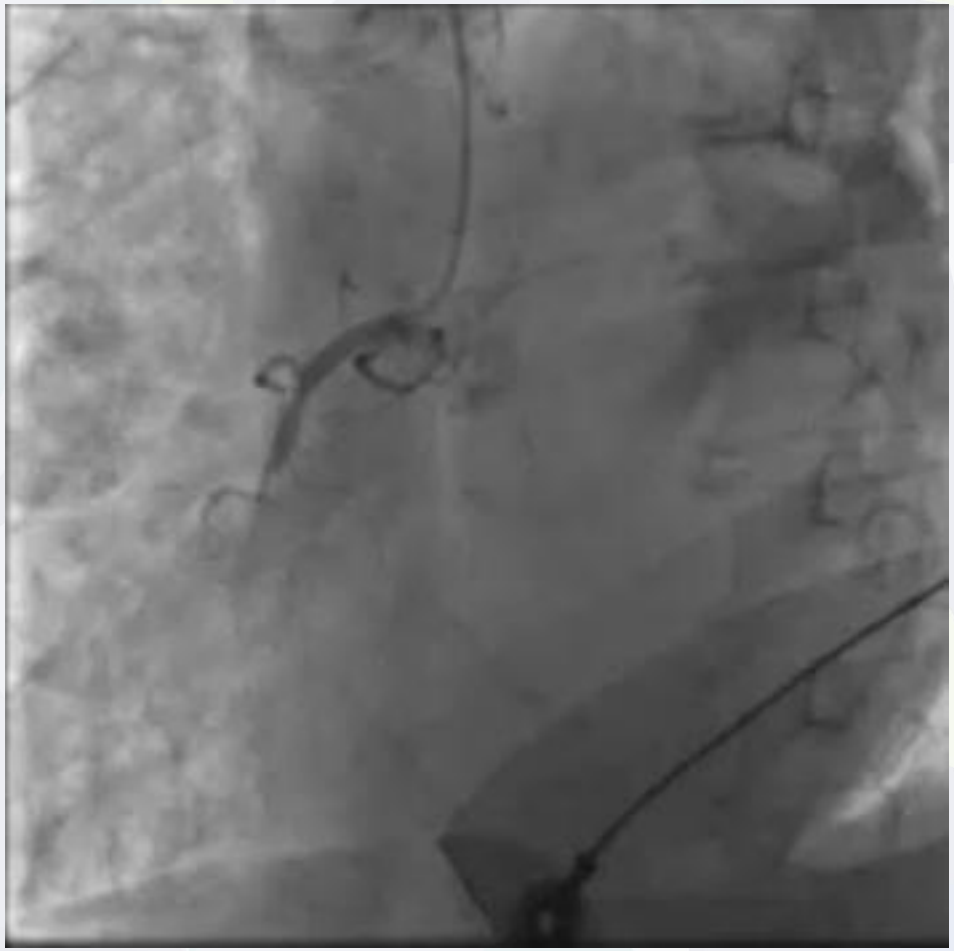
No reflow phenomenon
4 (3.1)

Stent thrombosis
1 (0.8)



MACE: muerte por cualquier causa, nuevo IAM o revascularización de lesion diana determinado por estadístico by Kaplan-Meier

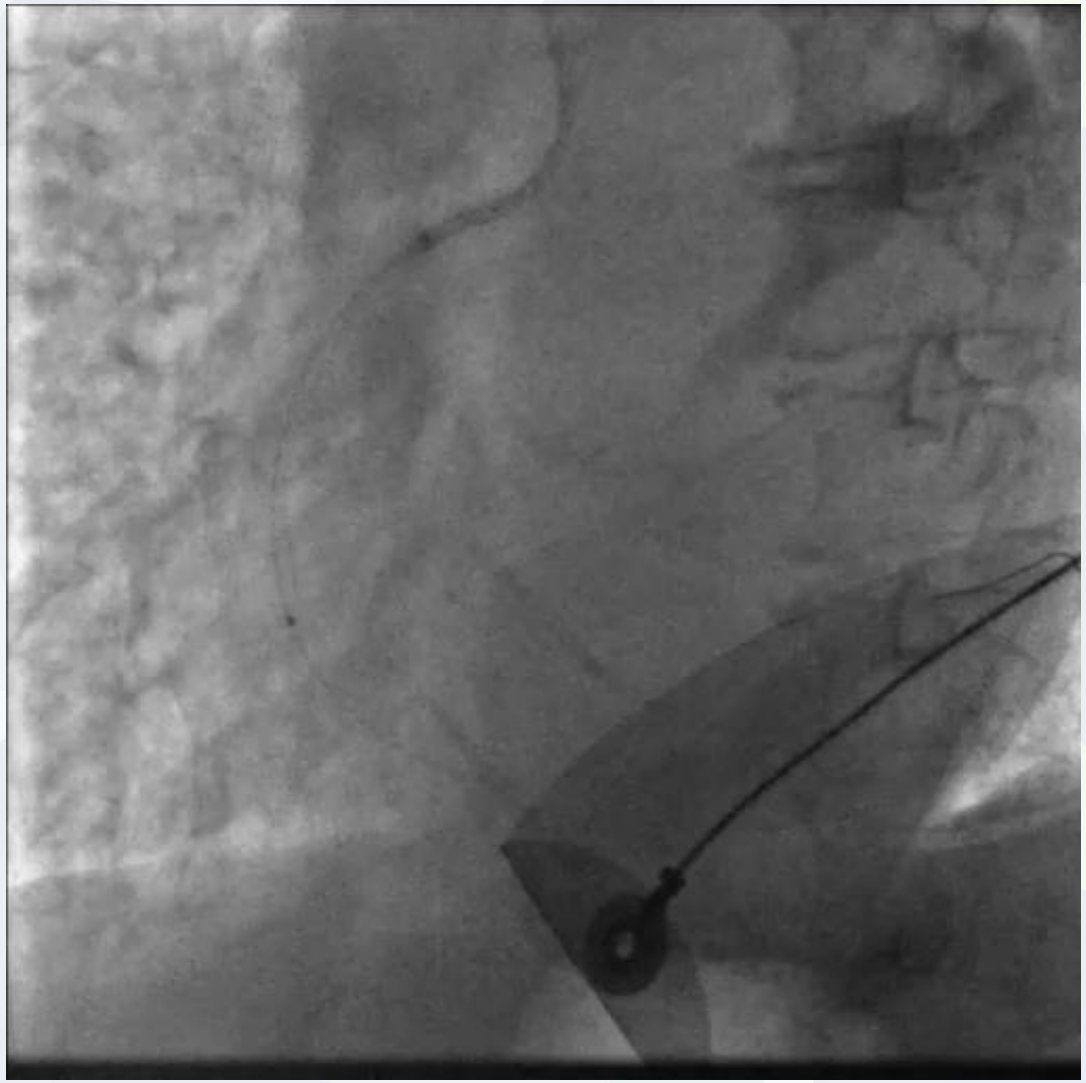
Mujer de 62 años que ingresa por IAM inferior KILLIP IV



Tromboaspiración

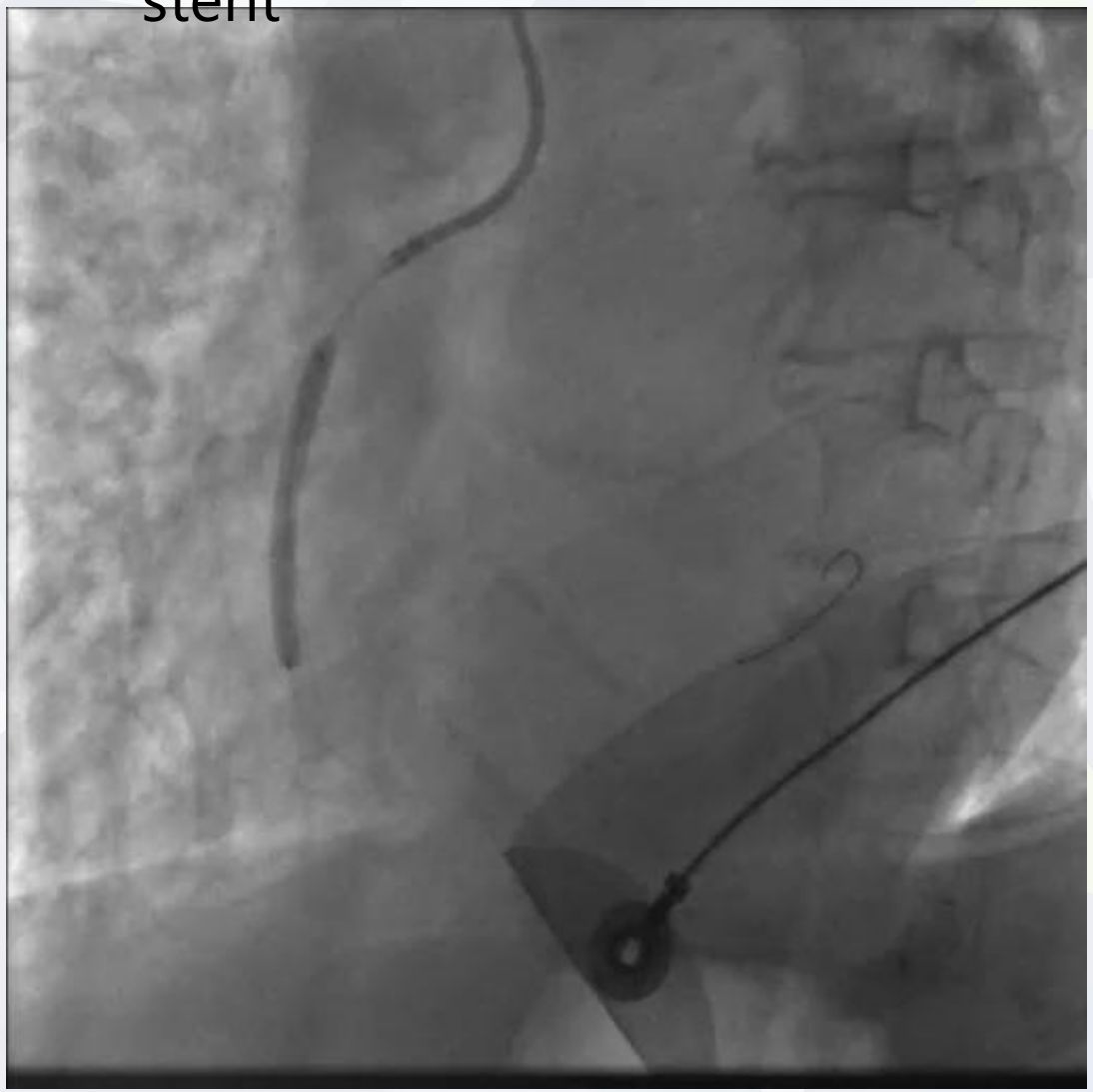
Tras tromboaspiración

ELCA



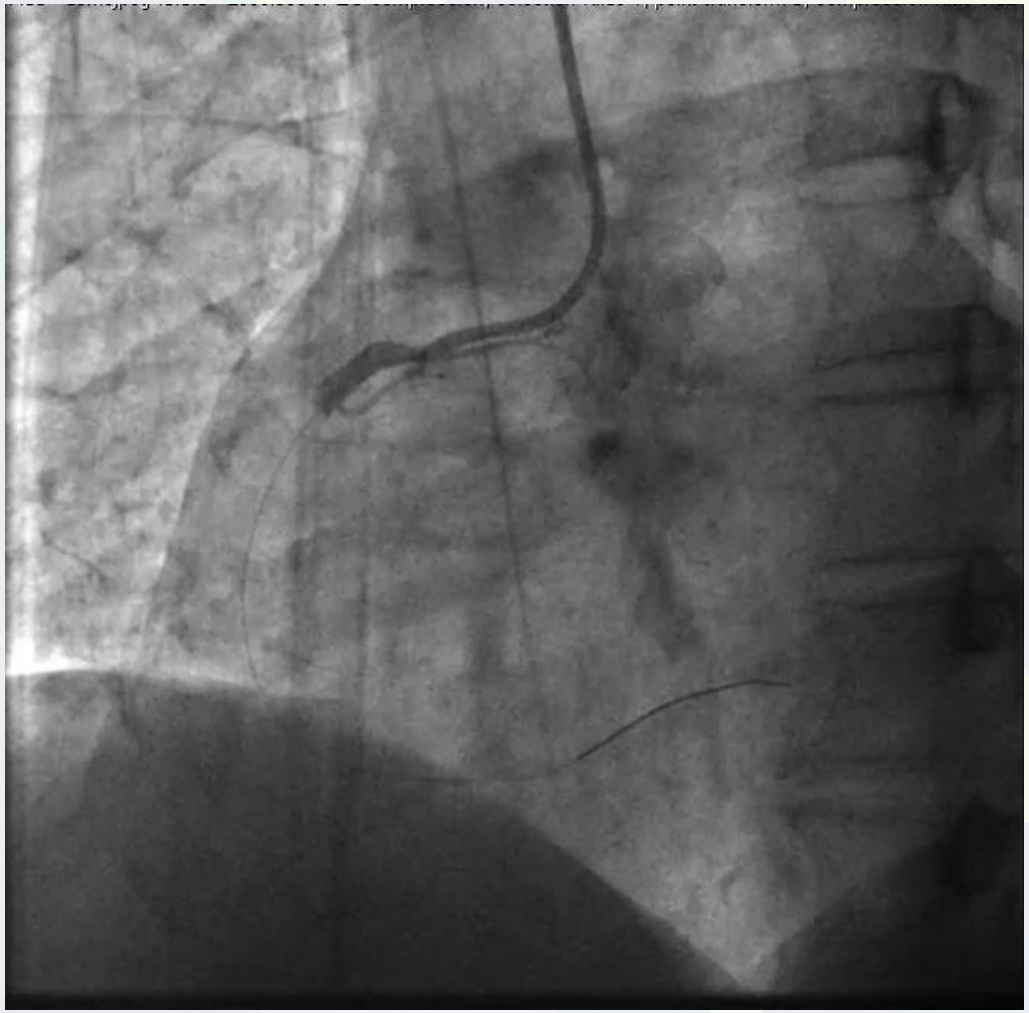
Tras ELCA

Implantación directa de stent

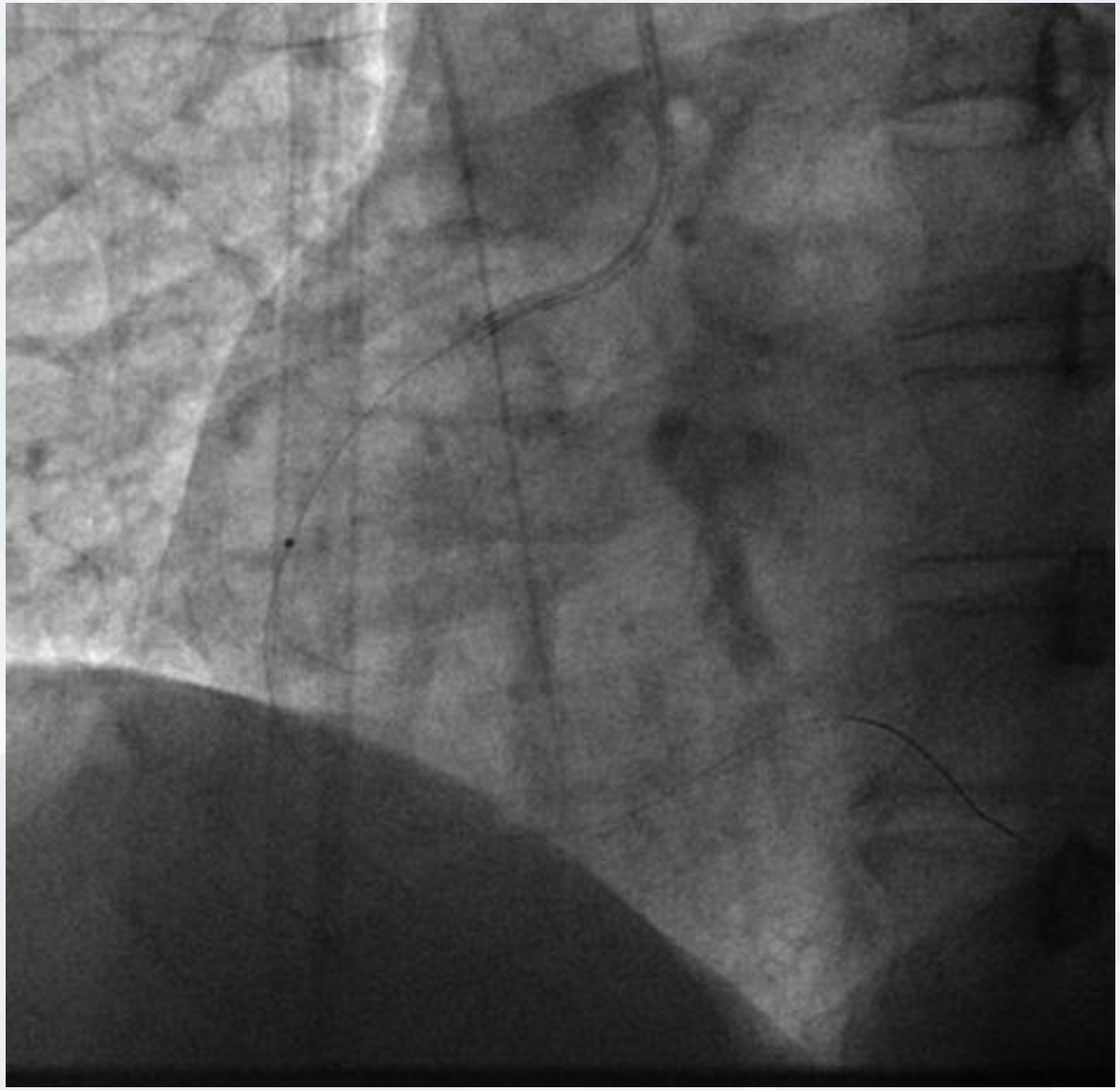


Resultado final

Mujer 49 años con IAM inferior: tromboaspiración no efectiva

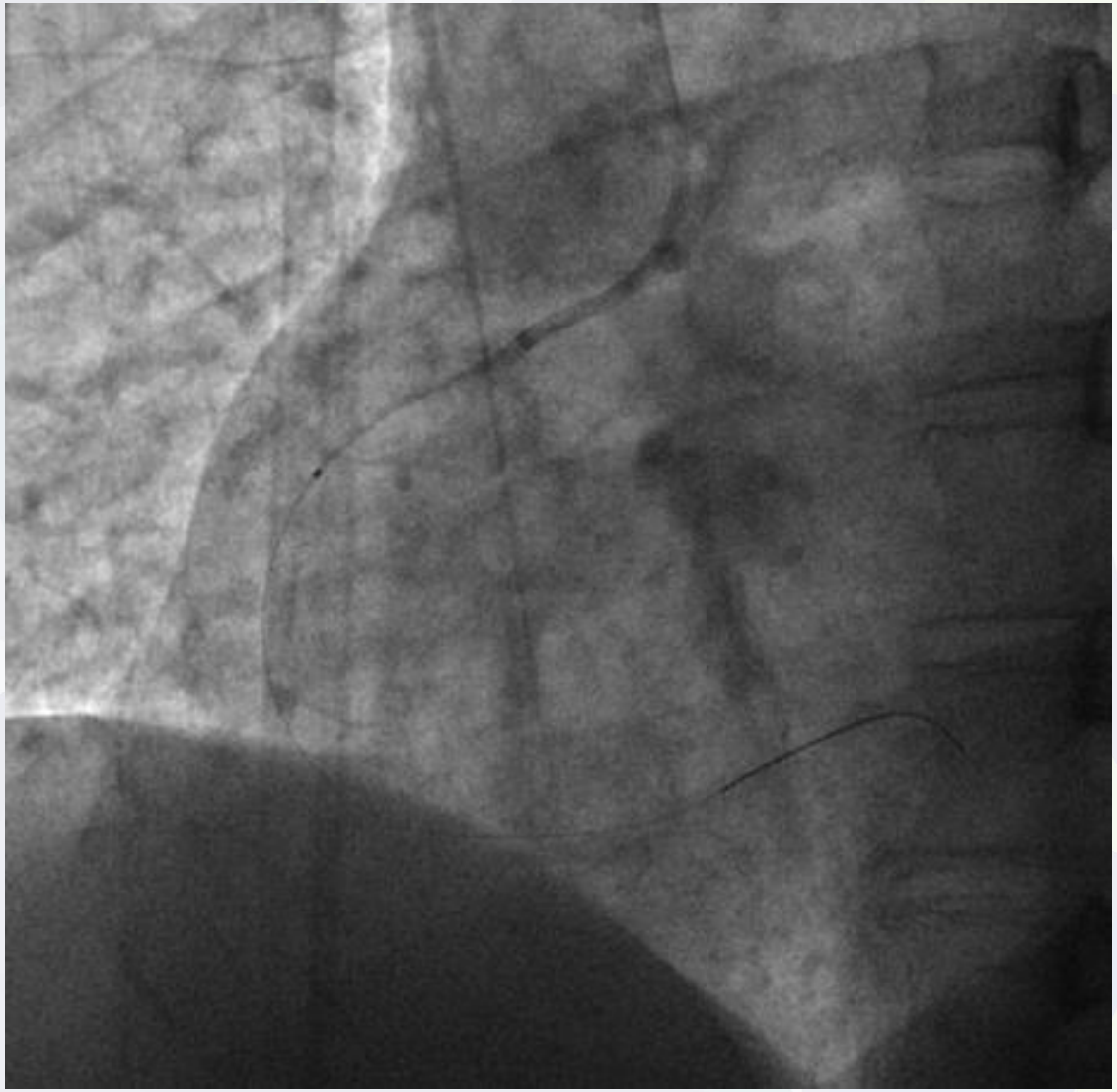


ELCA

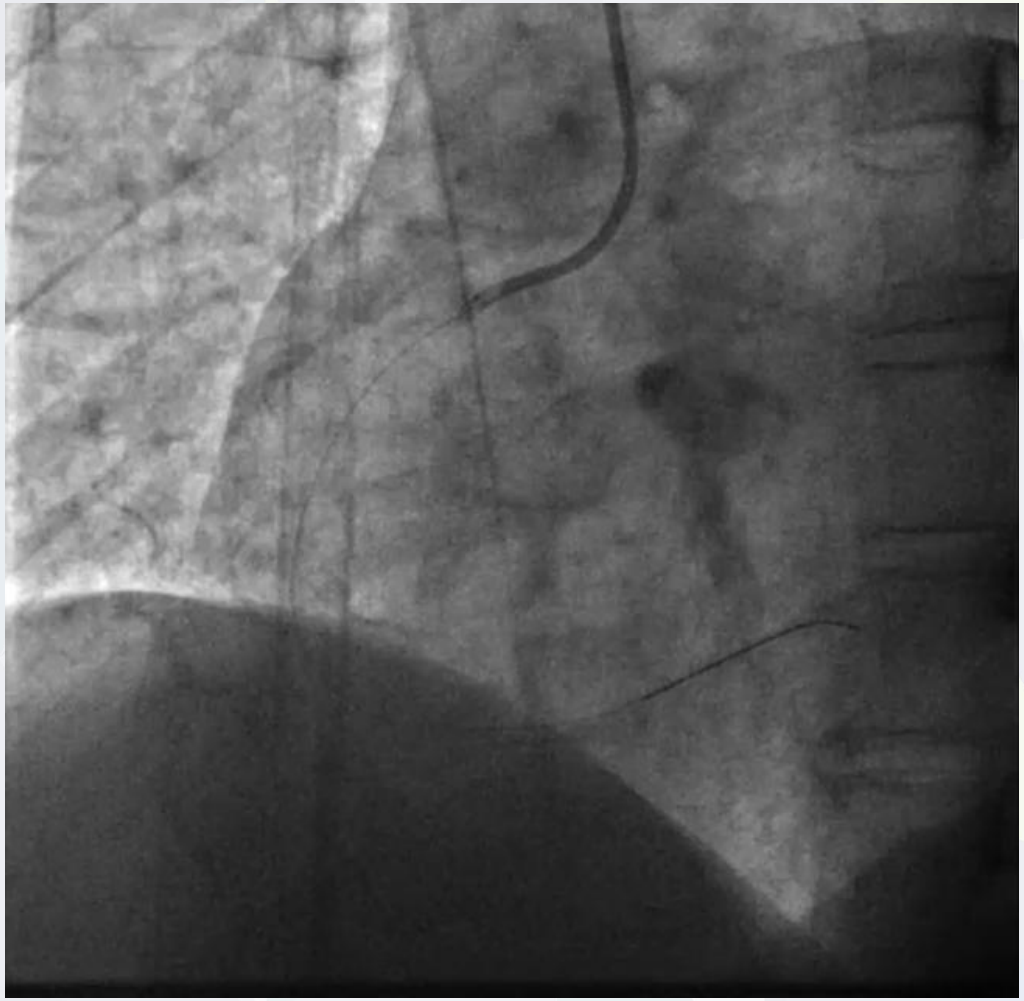


Post-ELCA

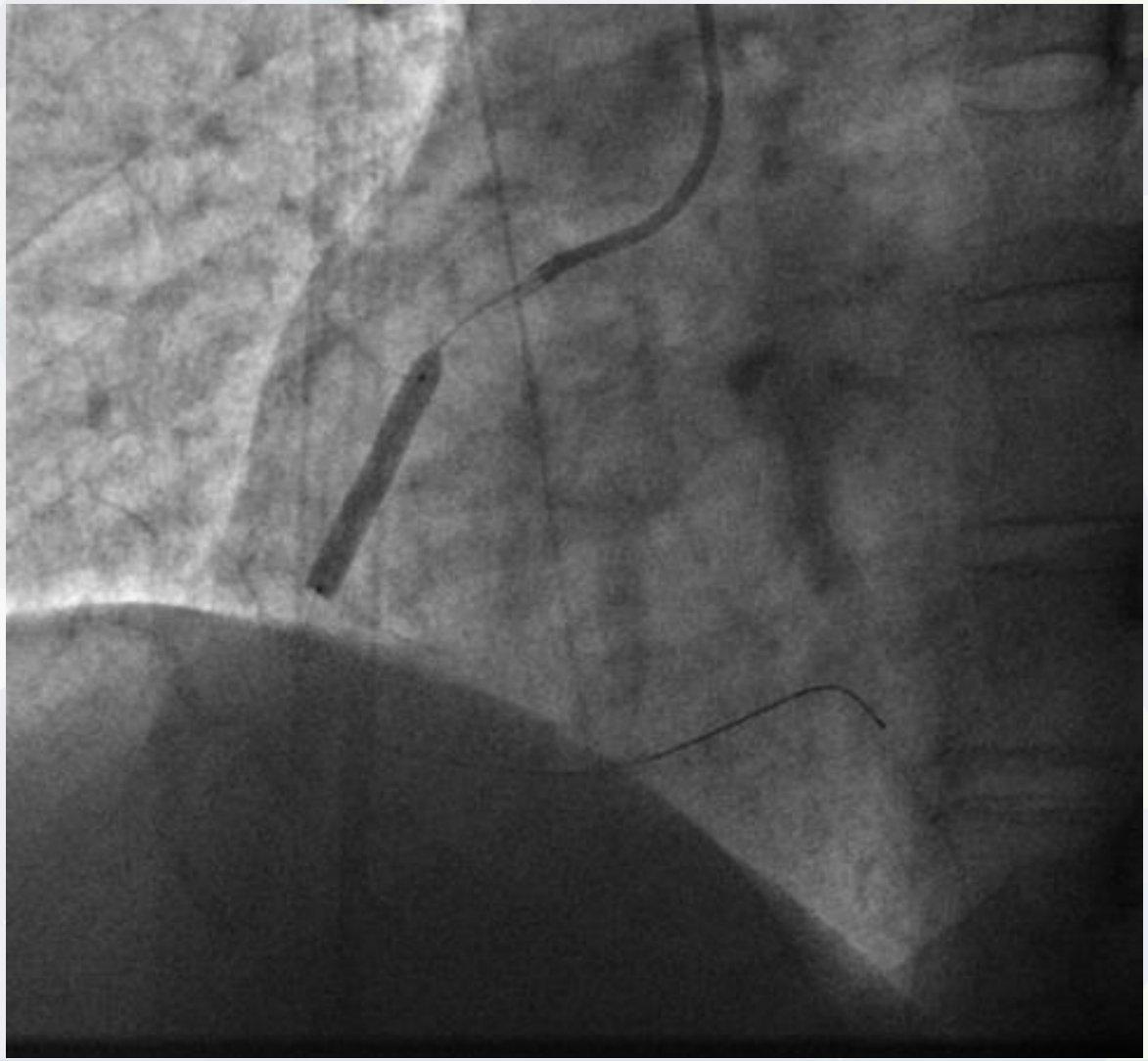
Tromboaspiración



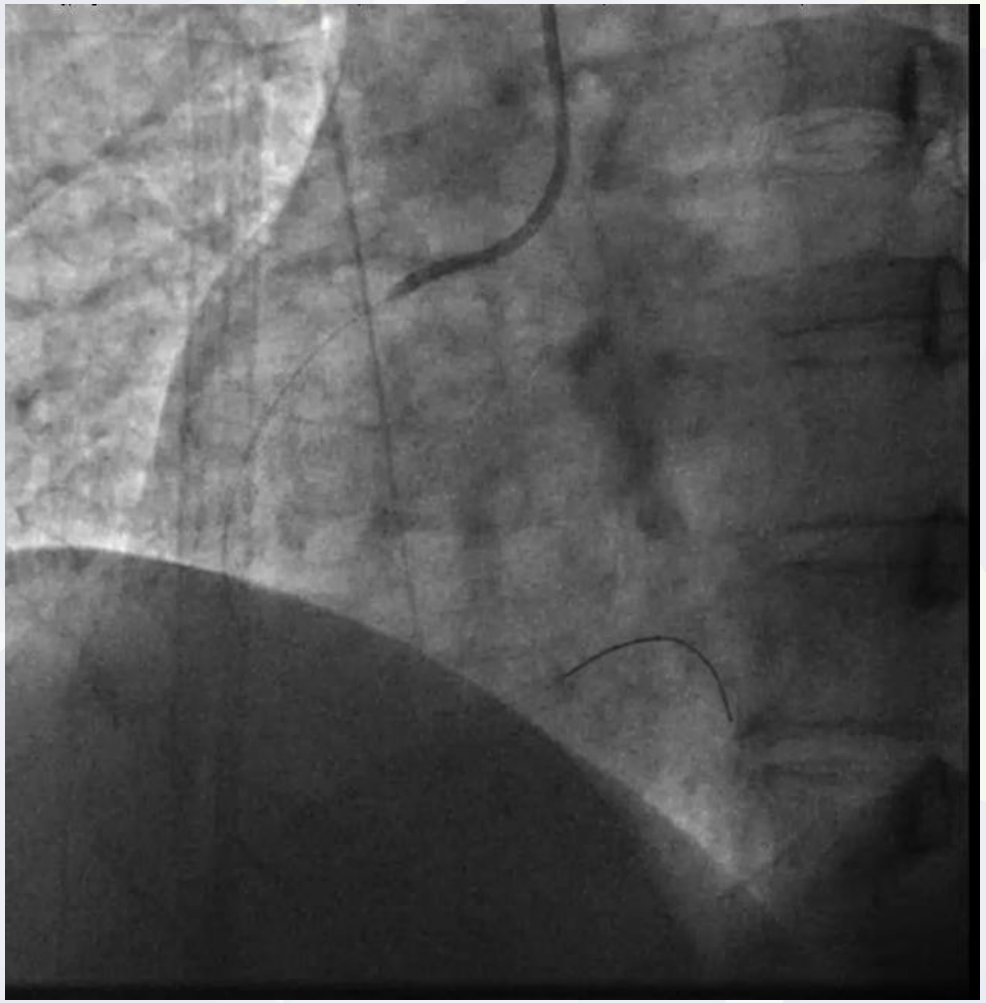
Tras tromboaspiración



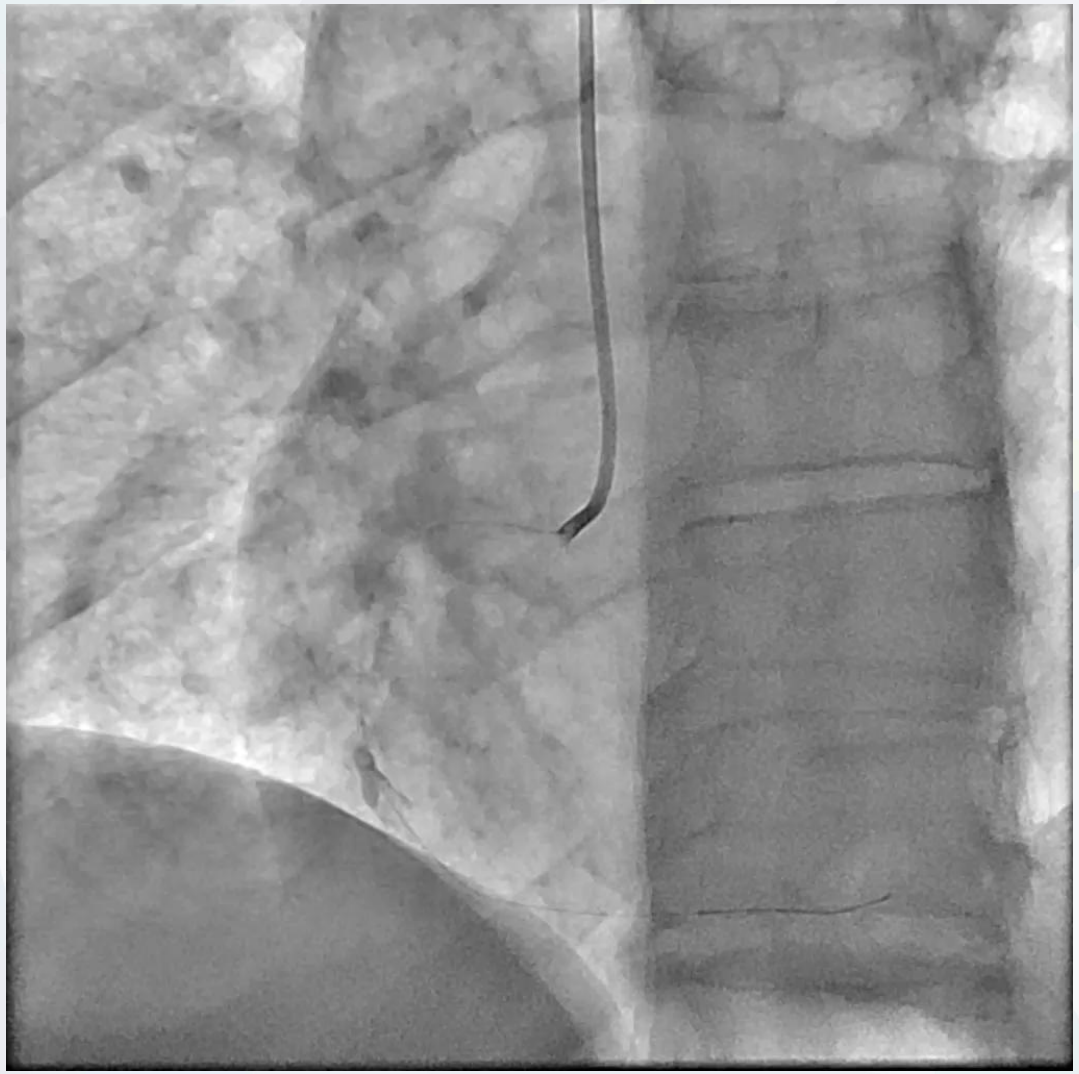
Implantación de stent

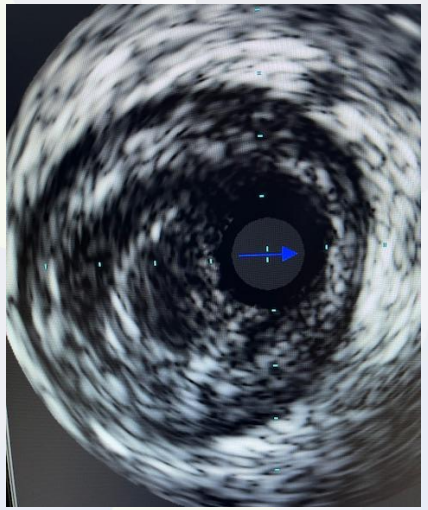


Resultado final



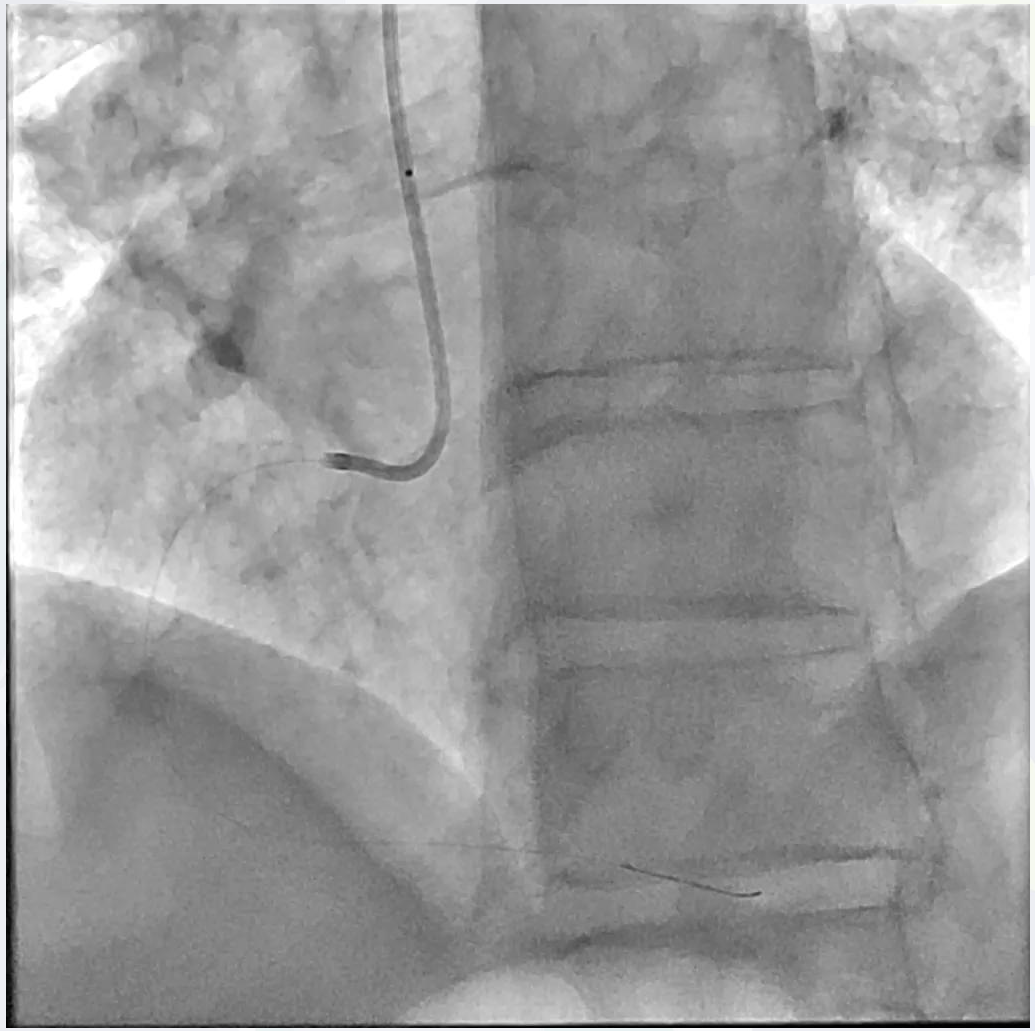
Varón 67 años; IAM inferior, CD ectásica, alta carga trombótica



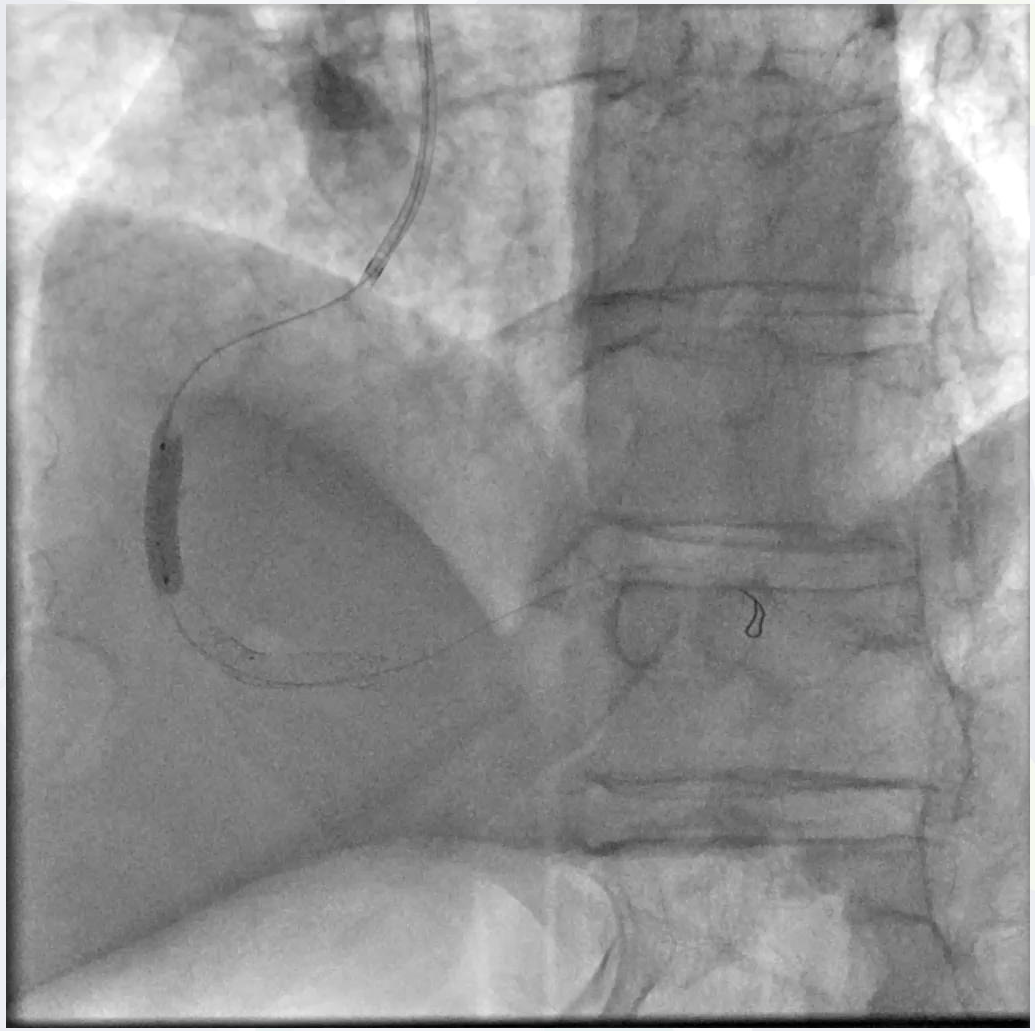


ELCA

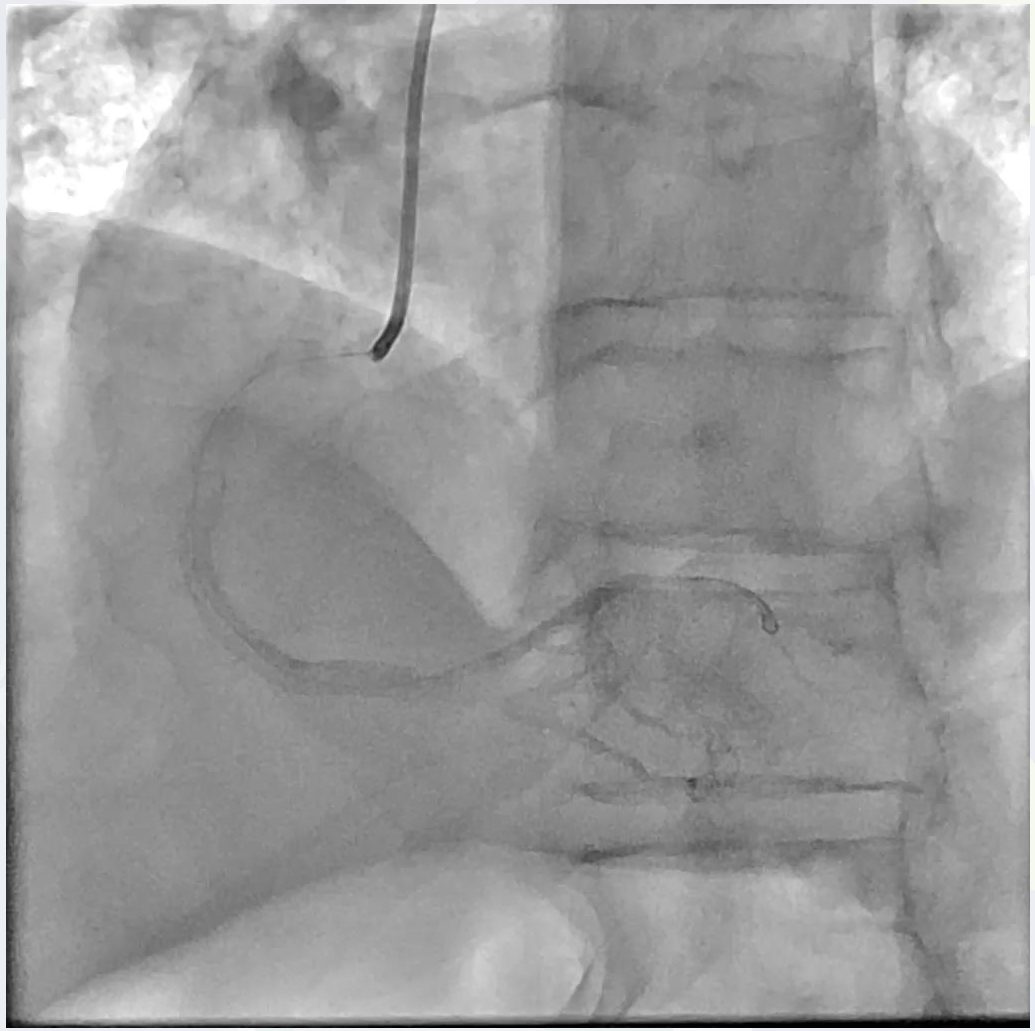
Tras ELCA



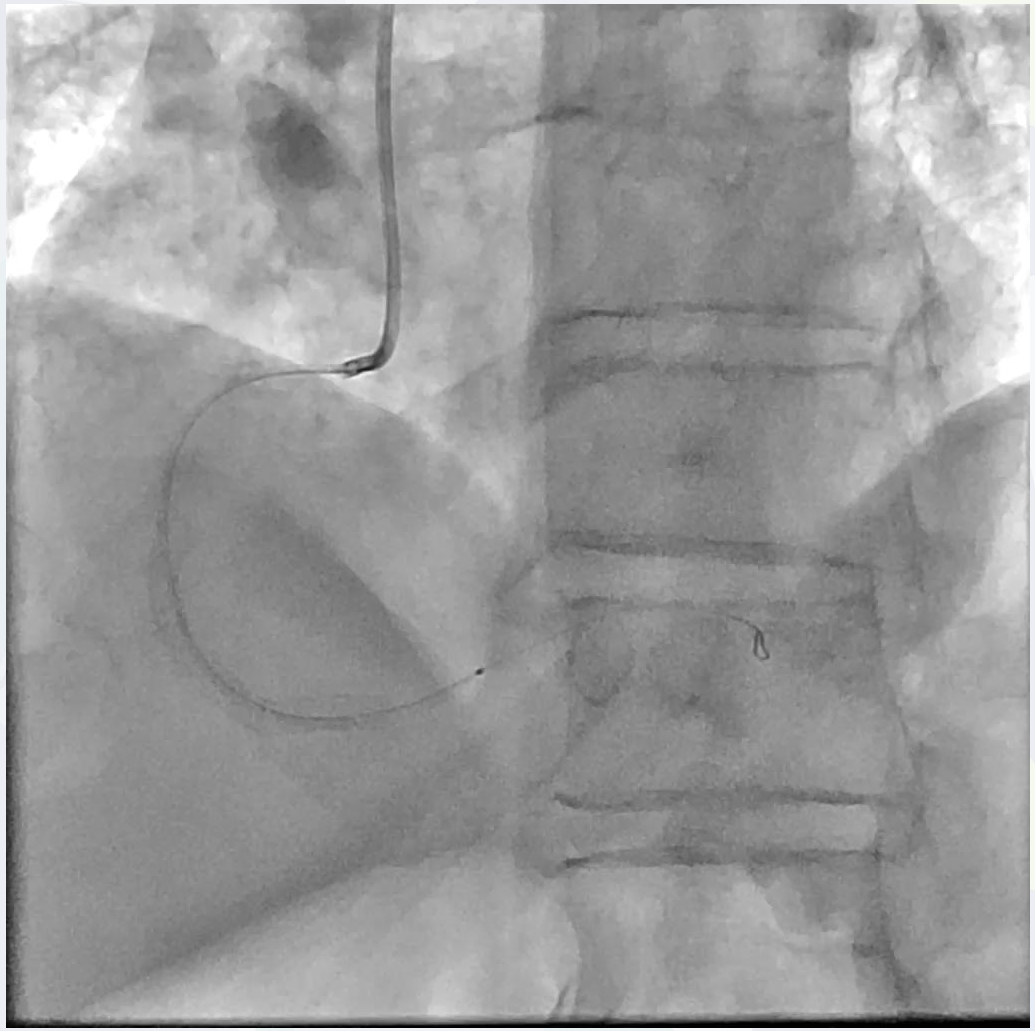
Implantación de 3 stents de 4.5 mm



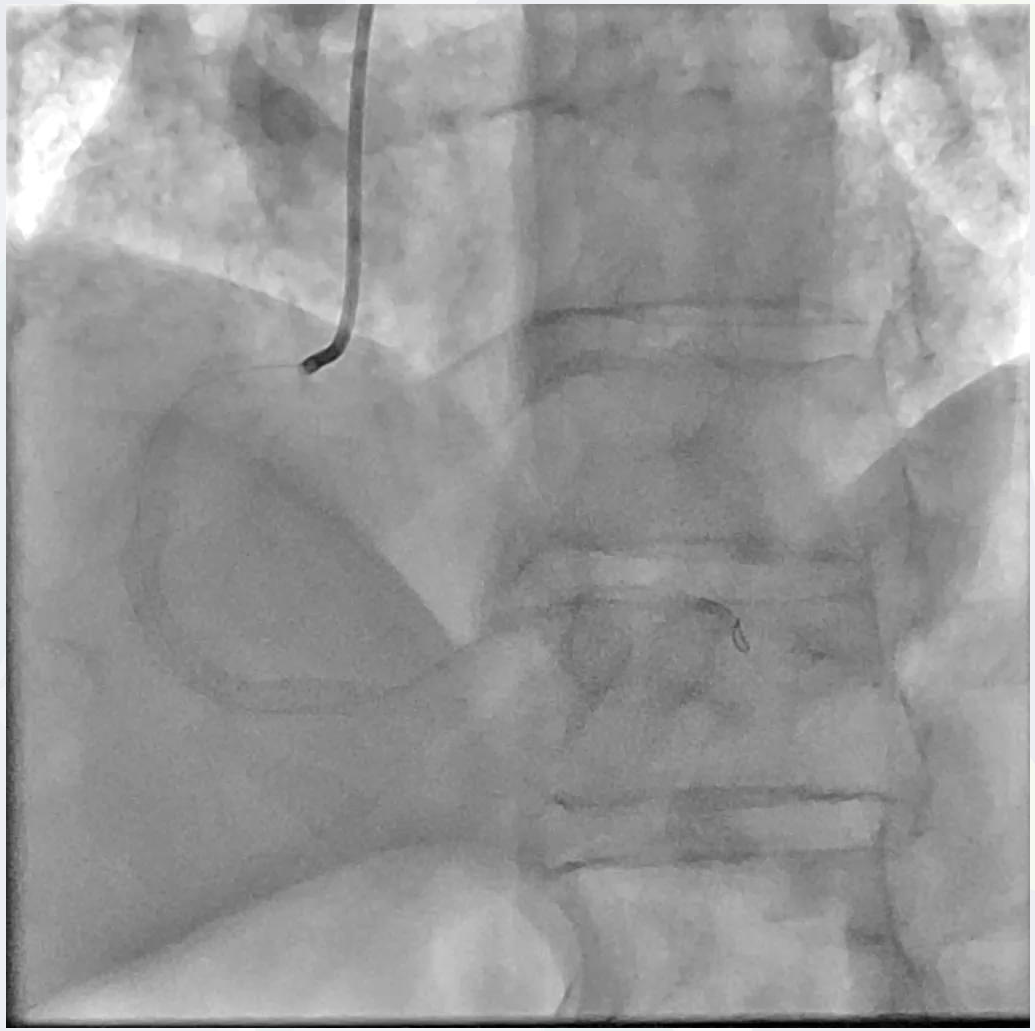
Trombo en PL



Tromboaspiración



Resultado final



Conclusiones

ELCA tiene capacidad de dislolución del trombo y es una herramienta más en el context de SCA especialmente con alta carga trombótica

En lesiones de alto contenido trombótico, ELCA parece capaz de dejar menos remanente trombótico en la arteria comparado con tromapiración

Estudios no aleatorizados sugieren mejores tasas de éxito técnico y probablemente mejor grado de TIMI y perfusión miocárdica comparado con tromboaspiración en ICP 1º,
pero faltan estudios aleatorizados para mostrar su impacto real a nivel de microcirculación

muchas gracias