
NSTITUTO NACIONAL DE CARDIOLOGIA
IGNACIO CHAVEZ

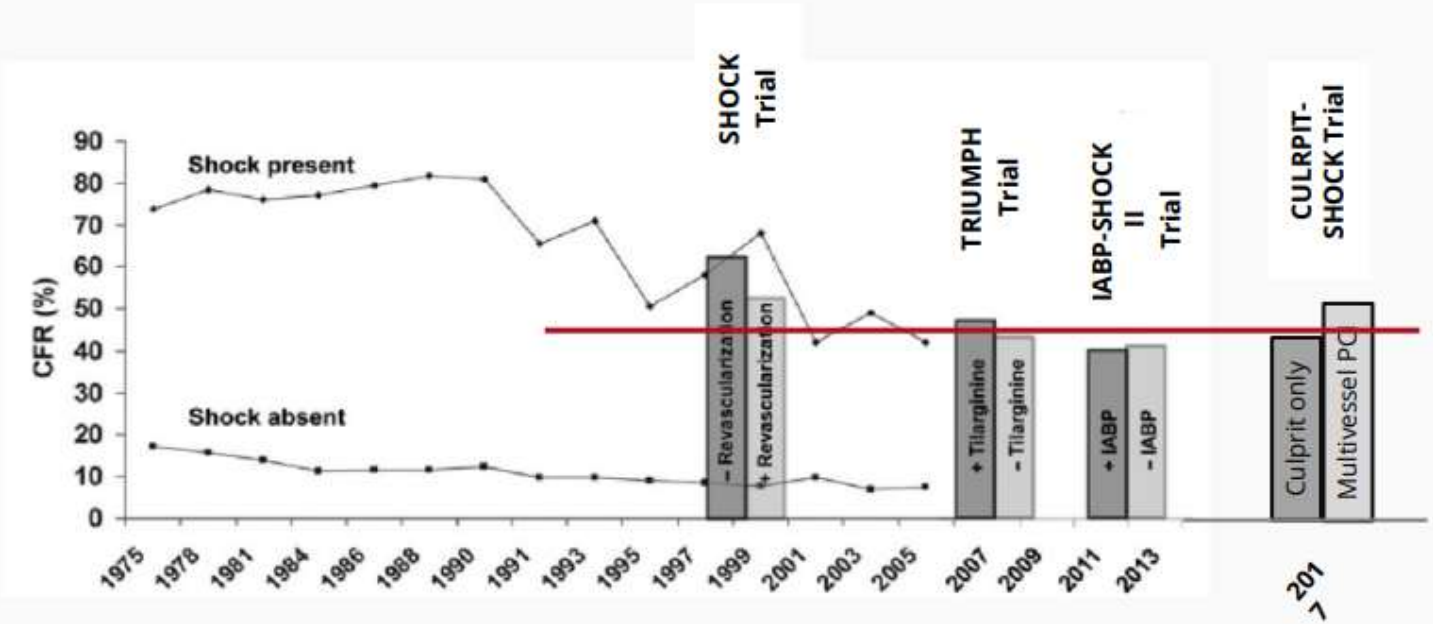
Soporte mecánico circulatorio en choque cardiogénico con Impella CP.

Dr. Gian Manuel
Jiménez Rodríguez

@drgianma

Background

Cardiogenic Shock - Mortality over Time



Adapted from Werdan et al. Eur Heart J 2014;35:156

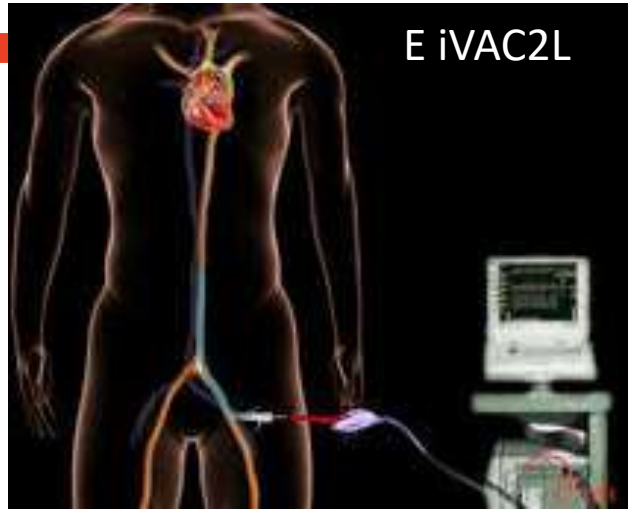
Plan de la sesión:

1) **Uso del dispositivo en choque cardiogénico.**
2) **Escalamiento.**
3) **Cuando NO usar el dispositivo**

Comparativo de dispositivos disponibles en LATAM.

	BIAC	iVAC2L	Impella CP	ECMO
Tamaño del acceso vascular	7.5 Fr a 8 Fr	17 Fr	14 Fr *	15 a 21 Fr
Asistencia máxima en litros.	0.5	2	3.7	4-7
Descarga VI	+	++	+++	-
Aumento de poscarga.	-	-	-	+++
Costo	+	++	+++	++
Curva de aprendizaje de uso.	++	+	+	+++

Ejemplos.



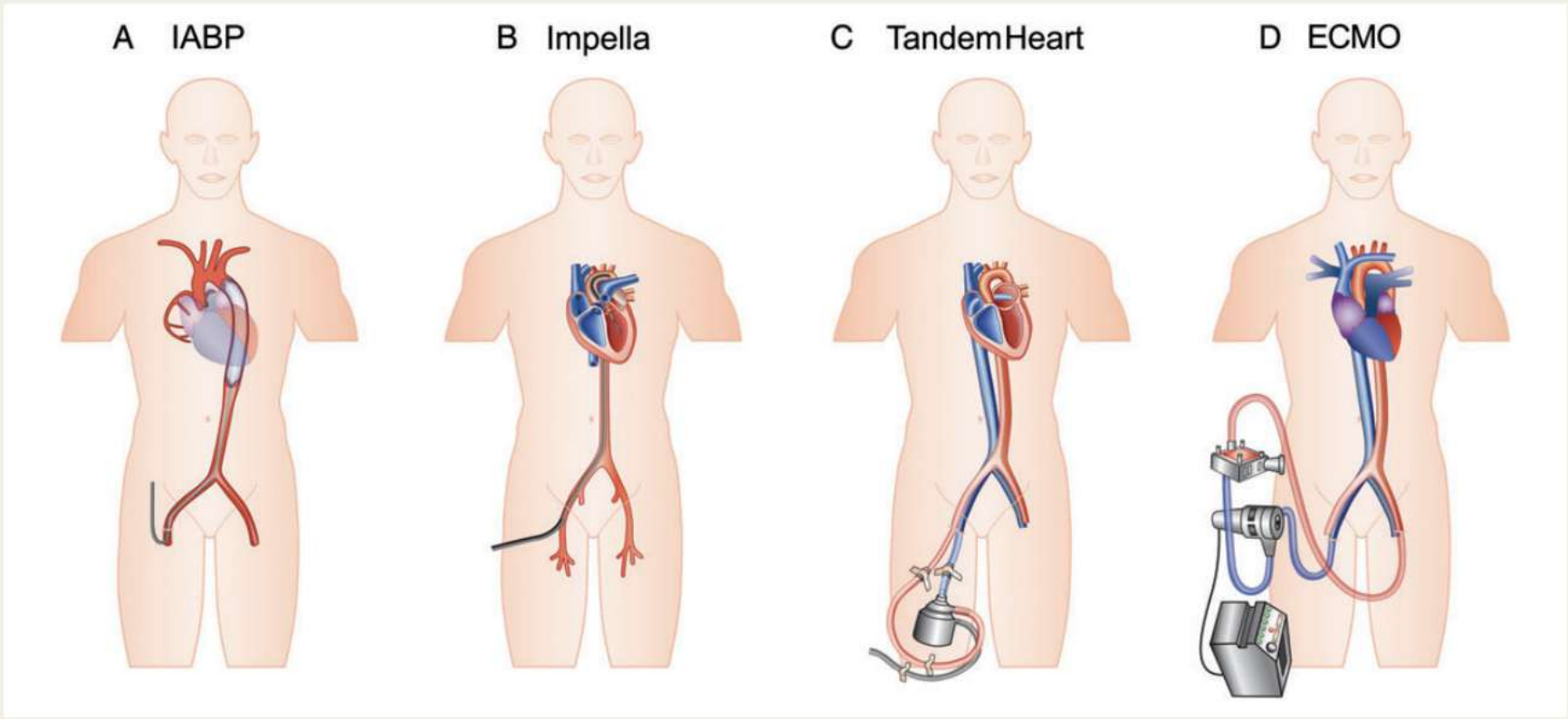
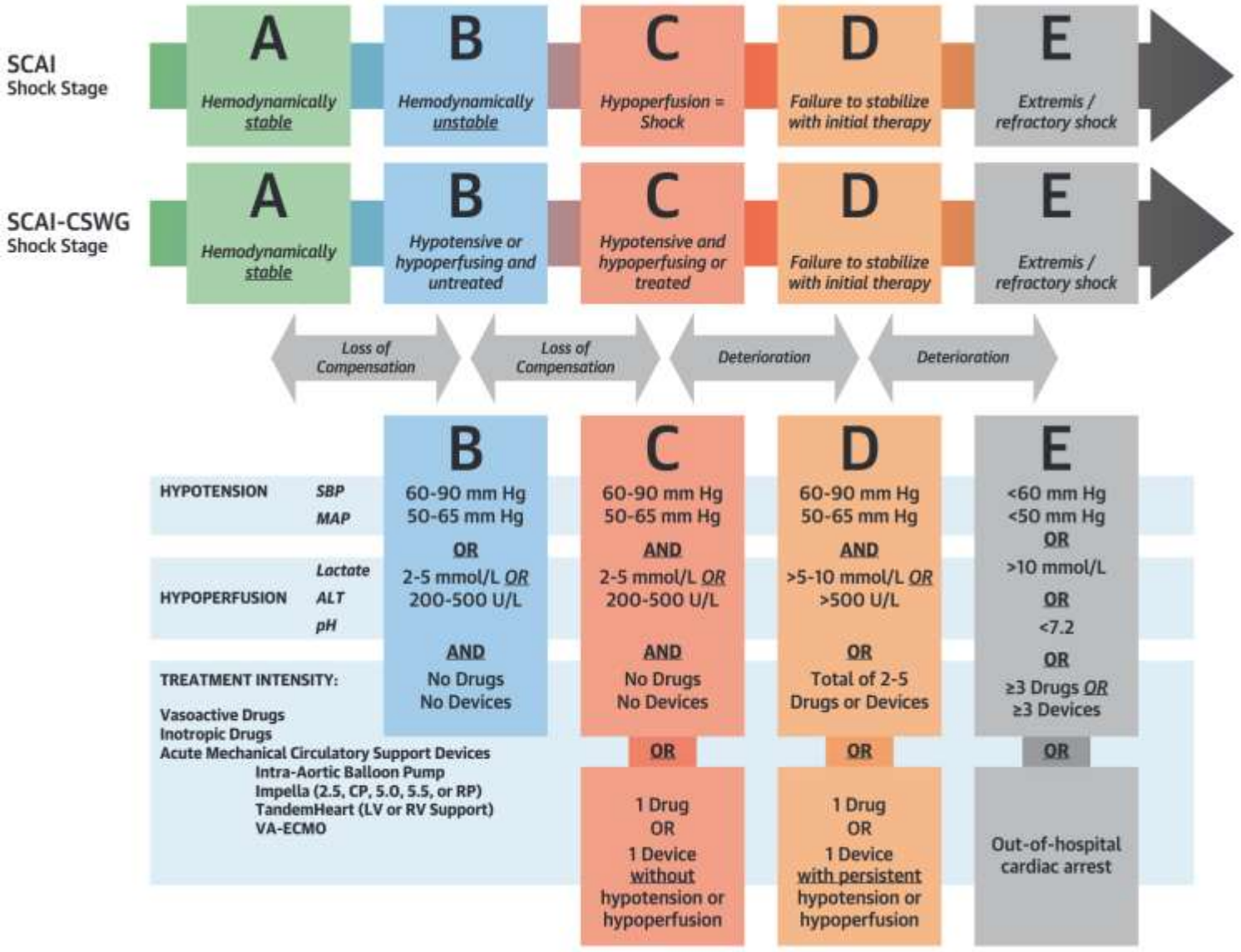


Figure 3 Percutaneous assist devices in cardiogenic shock. (*A*) Intra-aortic balloon counterpulsation; (*B*) Impella® pump; (*C*) TandemHeart™; (*D*) extracorporeal membrane oxygenation (ECMO). Modified from Thiele *et al.*[30]

Uso de dispositivos en choque.

Cardiogenic Shock Stage	Study Definition
Stage A ("At risk")	Neither hypotension/tachycardia nor hypoperfusion
Stage B ("Beginning")	Hypotension/tachycardia WITHOUT hypoperfusion
Stage C ("Classic")	Hypoperfusion WITHOUT deterioration
Stage D ("Deteriorating)"	Hypoperfusion WITH deterioration NOT refractory shock
Stage E ("Extremis")	Hypoperfusion WITH deterioration AND refractory shock

Jentzer, J.C. et al. J Am Coll Cardiol. 2019;74(17):2117-28.



Kapur NK, et al. J Am Coll Cardiol. 2022;80(3):185-198.

Escalamiento de asistencia.

- Considere escalamiento oportuno (menos de 4 horas).
- Continua tratamiento diurético.
- Asesore el escalamiento con catéter de flotación, PAPI, Poder cardiaco, IC, etc.

Serial Assessment

- Lactate
- Fick + thermodilution CO/CI
- CPO and PAPi

and if MCS

- Serial echocardiograms
- Assess for hemolysis
- Neurovascular assessments

*Criteria for Refractory Shock

- CPO <0.6W
- CI <2.2 l/min/m²
- ↑ Lactate

Contraindications To MCS

- Anoxic brain injury
- Irreversible end organ failure
- Prohibitive vascular access
- DNR

CPO = MAP x CO/451
PAPi = (sPAP-dPAP)/RA

Refractory Shock*

No

CPO >0.6W
PAPi >1.0
RA <15 mm Hg
PCWP <15 mm Hg

Wean vasopressors/ inotropes and assess for heart recovery

Yes

Bi-V CS
CPO <0.6W
PAPi <1.0
RA >15 mm Hg
PCWP >15 mm Hg

LV-dominant CS
CPO <0.6W
PAPi >1.0
RA <15 mm Hg
PCWP >15 mm Hg

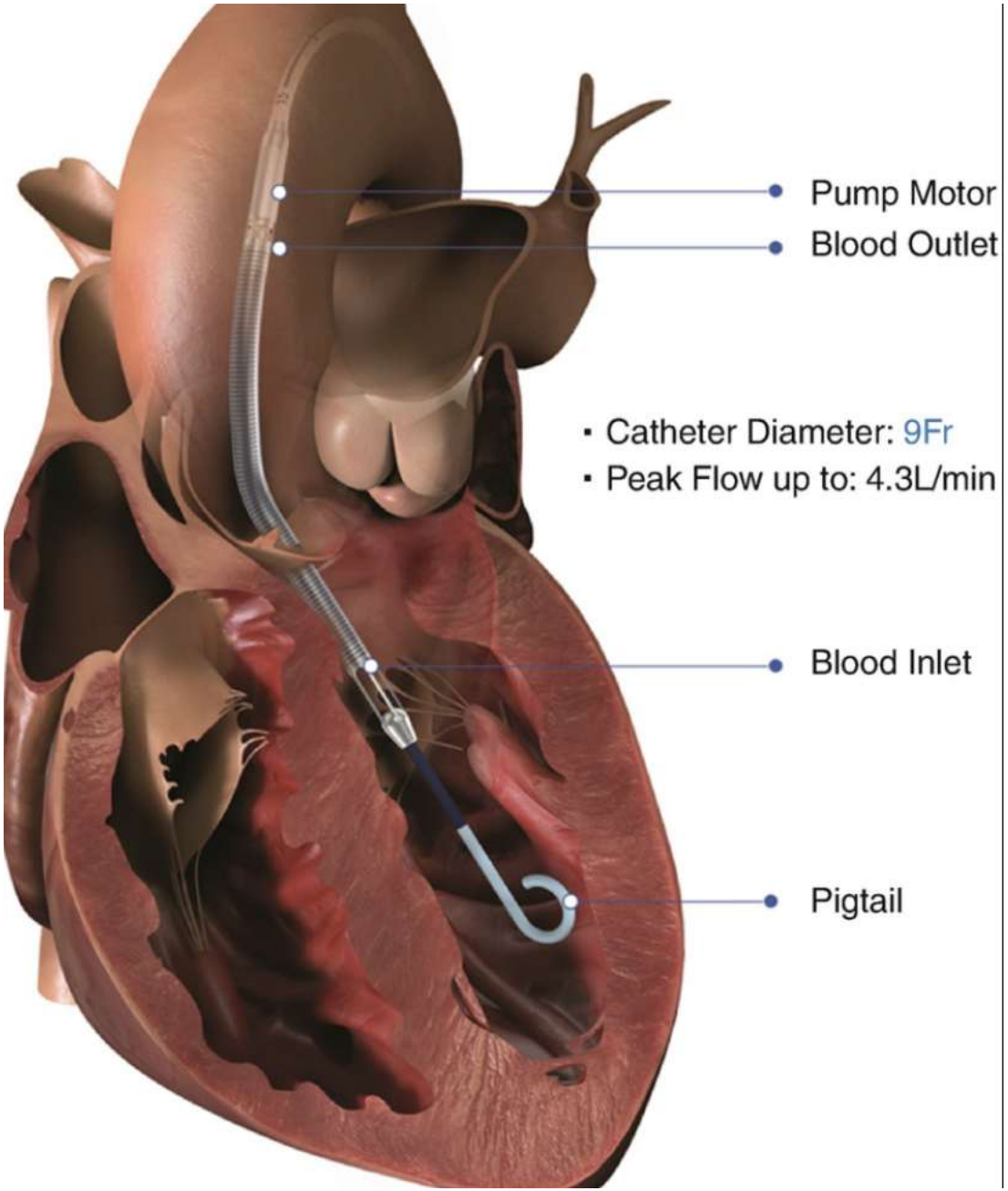
RV-dominant CS
CPO < 0.6W
PAPi <1.0
RA >15 mm Hg
PCWP <15 mm Hg

Multidisciplinary Shock Team Consultation

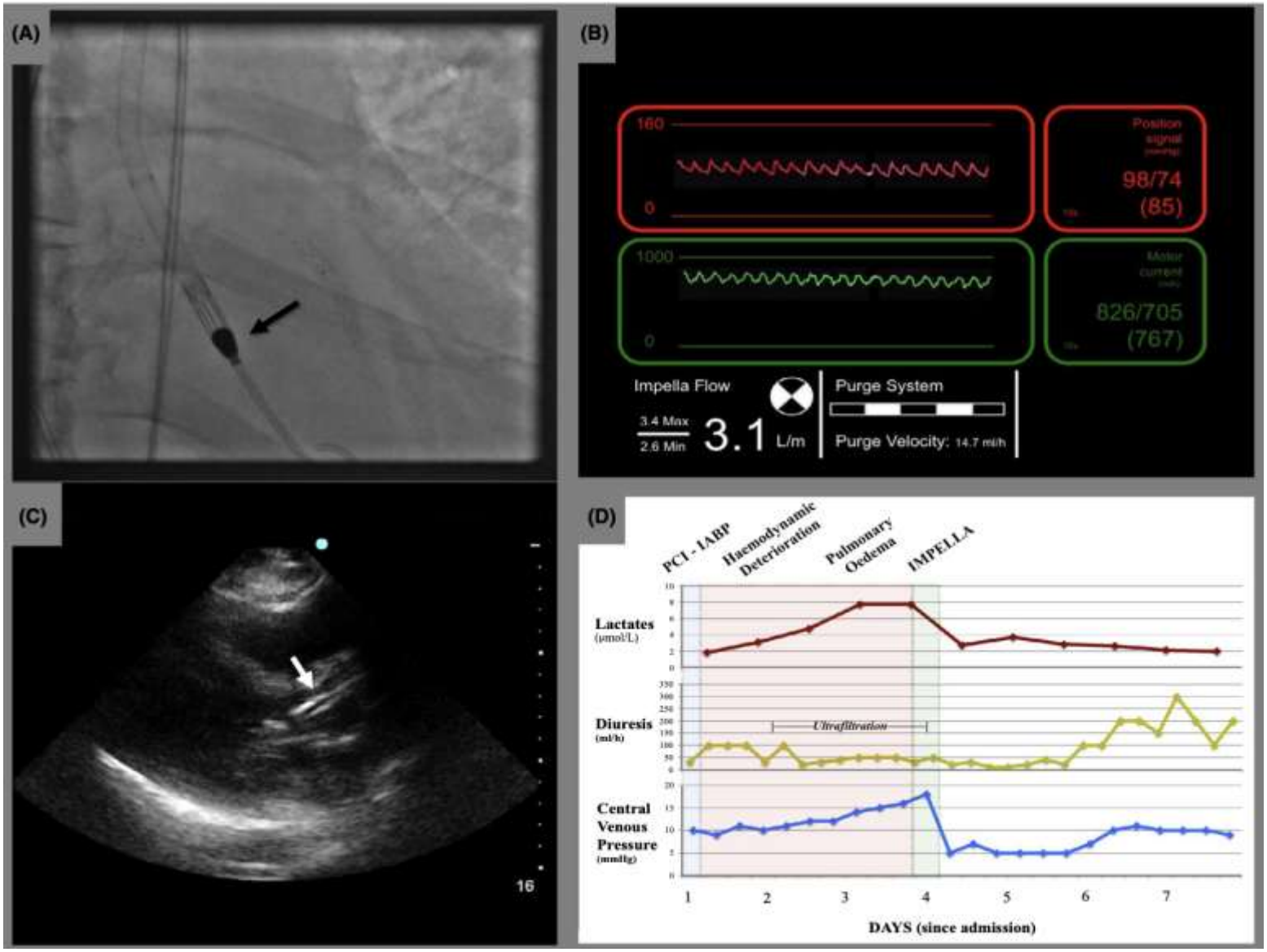
Assess Candidacy for Temporizing MCS

Bi-V CS	LV-dominant CS	RV-dominant CS
Hypoxemia	Hypoxemia	Hypoxemia
Yes: R + L pVAD with Oxygenator or VA-ECMO +/- LV Vent	Yes: L pVAD with Oxygenator or VA-ECMO +/- LV Vent	Yes: R pVAD with Oxygenator or VA-ECMO +/- LV Vent
No: R + L pVAD	No: L pVAD	No: R pVAD

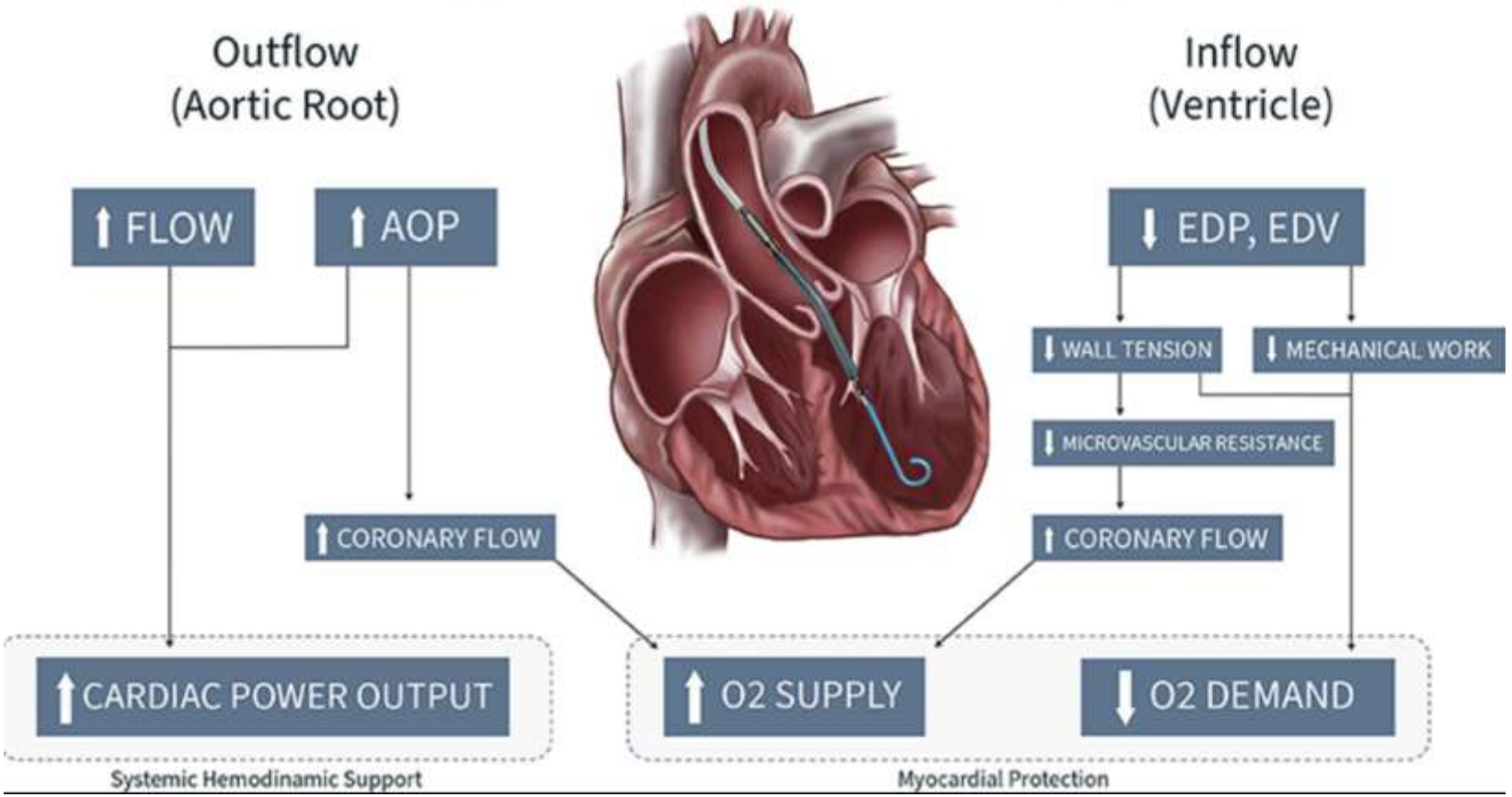
Impella CP.


Pump Motor
Blood Outlet
▪ Catheter Diameter: 9Fr
▪ Peak Flow up to: 4.3L/min
Blood Inlet
Pigtail

Impella CP.


(A)
(B)
160
0
Position signal
98/74
(85)
1000
0
Motor current
826/705
(767)
Impella Flow
3.4 Max
2.6 Min
3.1 L/m
Purge System
Purge Velocity: 14.7 ml/h
(C)
16
(D)
PCI - IABP
Haemodynamic Deterioration
Pulmonary Oedema
IMPELLA
Lactates
(μmol/L)
Diuresis
(ml/h)
Ultrafiltration
Central Venous Pressure
(mmHg)
1
2
3
4
5
6
7
DAYS (since admission)

Impella CP.


Outflow
(Aortic Root)
Inflow
(Ventricle)
FLOW
AOP
EDP, EDV
WALL TENSION
MECHANICAL WORK
MICROVASCULAR RESISTANCE
CORONARY FLOW
CORONARY FLOW
CARDIAC POWER OUTPUT
O2 SUPPLY
O2 DEMAND
Systemic Hemodinamic Support
Myocardial Protection

PROTECTED PCI ALGORITHM

LVEF < 50%: EVALUATE ALGORITHM

LVEF < 40%: RECOMMEND RHC PRIOR TO PCI

- +2 Cardiac index < 2.0 L/min/m^2 or PA sat < 55%
- +1 Syntax score ≥ 22
- +1 Ejection fraction < 25%
- +1 Systolic BP < 100 mm Hg at baseline
- +1 ACS presentation
- +1 Planned revascularization > 2 territories
- +1 Likely prolonged ischemia
  - Retrograde chronic total occlusion
  - Atherectomy
- +1 Severe mitral regurgitation
- +1 Decompensated state
  - LVEDP > 20 mm Hg
  - Significant new orthopnea
- -1 High-risk vascular injury/significant bleeding
- -1 Hemoglobin < 8 g/dL

0-2 → UNLIKELY TO NEED SUPPORT

3 → CONSIDER SUPPORT

≥4 → STRONGLY CONSIDER SUPPORT

McCabe JM. Hemodynamic support for CTO PCI: who, when, & how. Presented at Transcatheter Cardiovascular Therapeutics (TCT); September 21-25, 2018; San Diego, California.

Definición de ICP de alto riesgo.

- Intervención en el último vaso remanente.
- Enfermedad de tronco no protegido.
- Enfermedad compleja de tres vasos y riesgo de isquemia durante el procedimiento.
- Uso de aterectomía.
- Cruce retrógrado de colaterales en casos de ICP en OTC.
- Paciente con isuficiencia cardiaca descompensada o FEVI disminuida <35%.

Algoritmo para escalamiento.

- En caso de que se inicie con BIAC y el CPO continua por debajo de 0.6 se sugiere escalar a Impella CP o ECMO.
- En caso de iniciar con Impella CP y el CPO continua por debajo de 0.6 se sugiere escalar a ECMO.

A Standardized and Comprehensive Approach to the Management of Cardiogenic Shock
https://doi.org/10.1016/j.jchf.2020.09.005
VOL. 8, NO. 11, 2020

Cuando NO usar el dispositivo.

1) Contraindicación absoluta para anticoagulación.
2) Inserción en parada cardiaca.
3) No se sugiere iniciar Impella CP en estadio E.
4) Incapacidad de uso de femorales***.

Beneficios Impella CP.

1. ICP primaria en choque cardiogénico.
2. ICP urgente en paciente con compromiso hemodinámico.
3. Permite realizar revascularización completa en lesión grave de tronco y FEVI baja[1].
4. Reduce sintomas de falla cardiaca y aumenta FEVI cuando la ICP se completa con éxito[2].
5. Reducción en la incidencia de lesión renal aguda[3].
6. Reducción en dias de hospitalización [4,5].
7. Reducción significativa de MACE (compuesto de muerte, EVC, infarto de miocardio y nueva revascularización)[6].

1.Burzotta, F., et al. (2019). *J Interv Cardiol, 2019*(5):1-10.
2.O'Neill, W.W., et al. (2012). *Circulation, 126*(14), 1717-1727.
3.Flaherty, M.P., et al. (2017). *Circ Res, 120*(4), 692-700.
4.Gregory, D., et al. (2013). *Am Health Drug Benefits, 6*(2), 88-99.
5.Maini, B., et al. (2014). *Expert Rev Pharmacoecon Outcomes Res, 14*(3), 403-416.
6.Dangas, G.D., et al. (2014). *Am J Cardiol, 113*(2), 222-228.

Beneficios Impella CP.

Revascularización completa asociada con mejores resultados

1) Beneficios en pacientes con **síndrome coronario agudo (SCA)** de alto riesgo al año [1]

a) 71% de **reducción del riesgo de muerte** por todas las causas.

b) 27% de reducción del riesgo de eventos cardiovasculares adversos mayores (MACE).

c) 41% de **reducción del riesgo de infarto** de miocardio (MI).

2) Beneficios en pacientes con **IAMCEST** de alto riesgo a los 3 años[2]

a) 26 % de **reducción del riesgo de muerte** cardiovascular (CV)/IM.

b) Reducción del riesgo del 47 % en muerte CV/IM/revascularización.

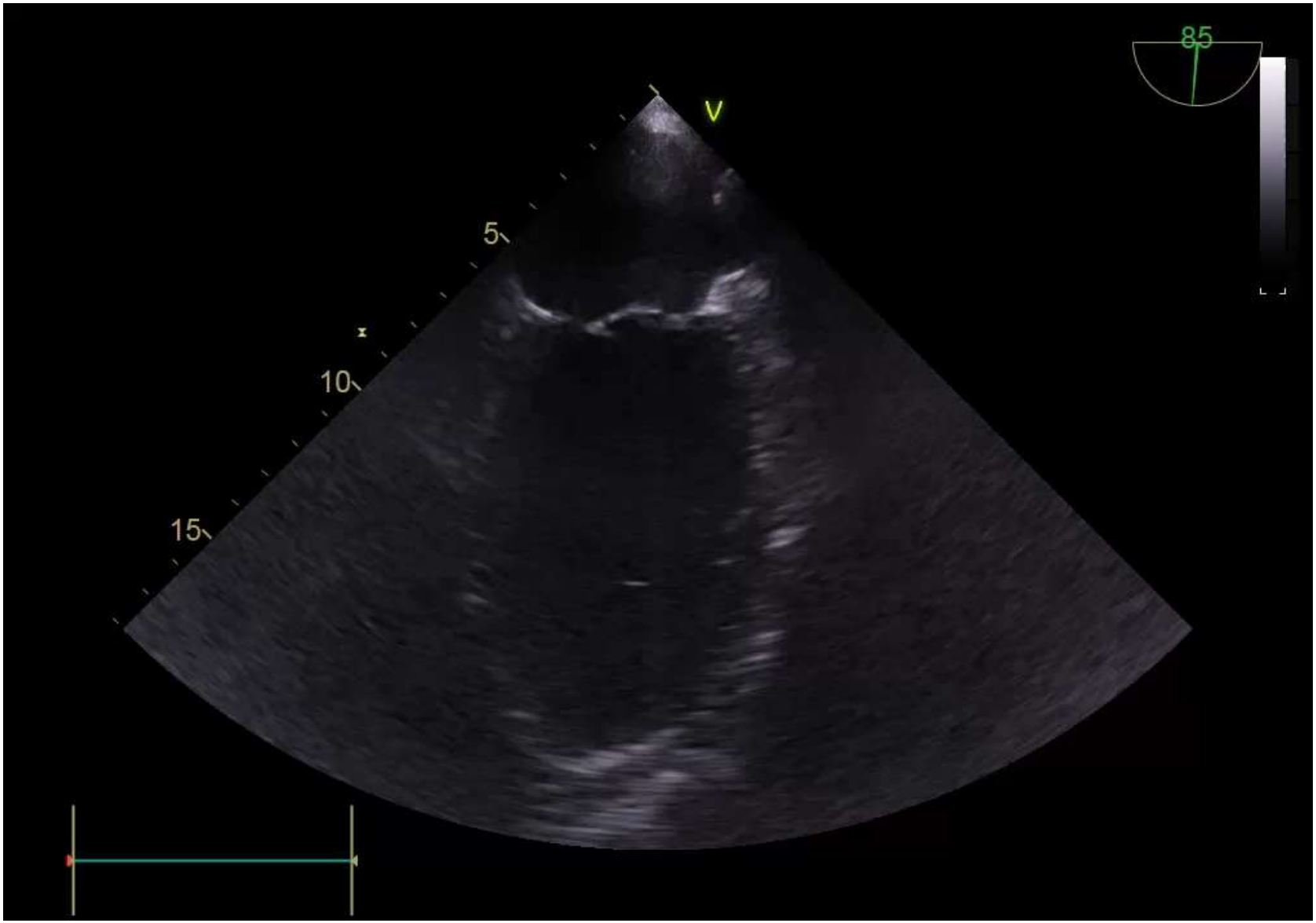
3) **Metanálisis** de beneficios en 11 estudios STEMI de alto riesgo[3]

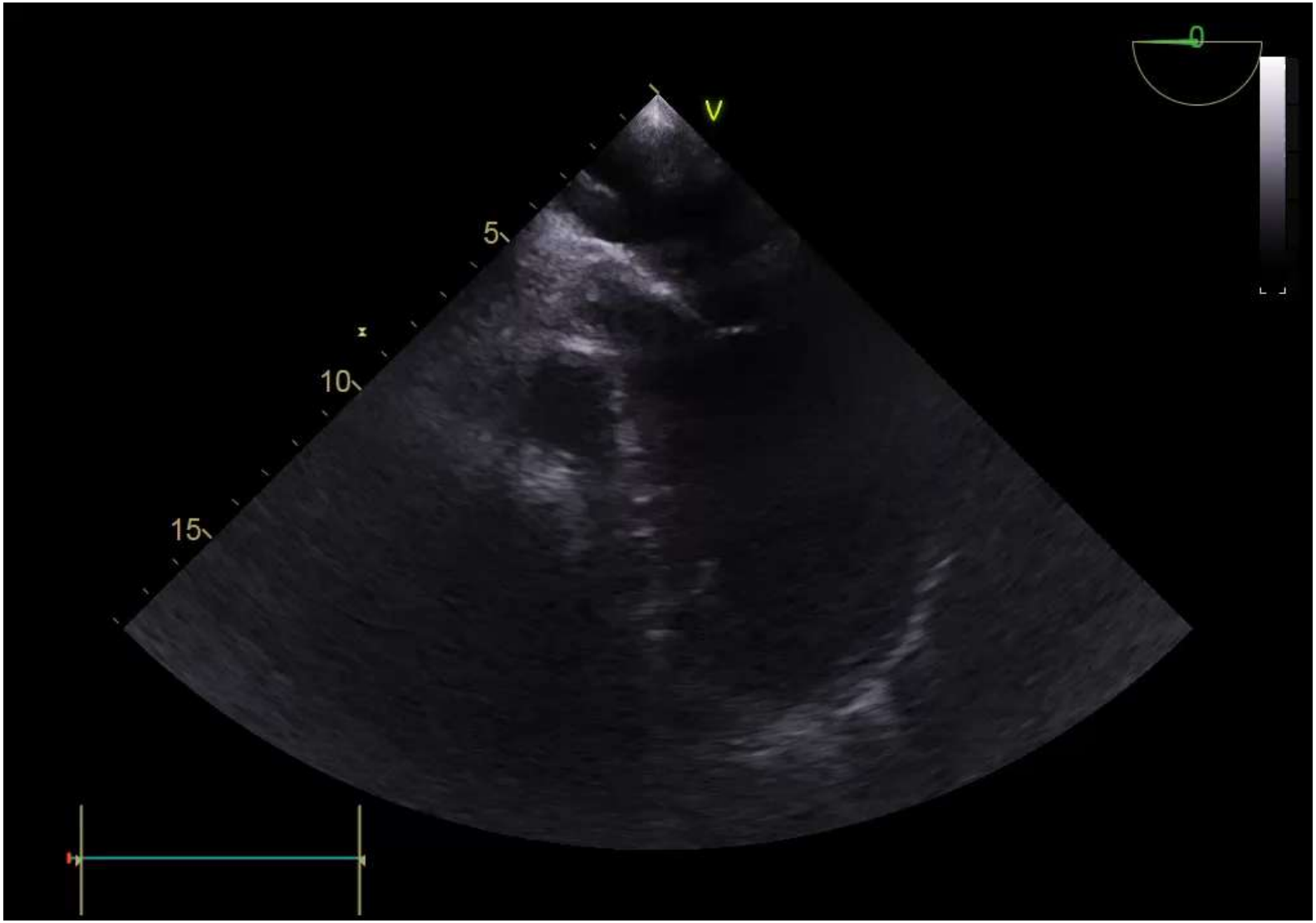
a) 29 % de **reducción del riesgo de muerte** CV/IM.

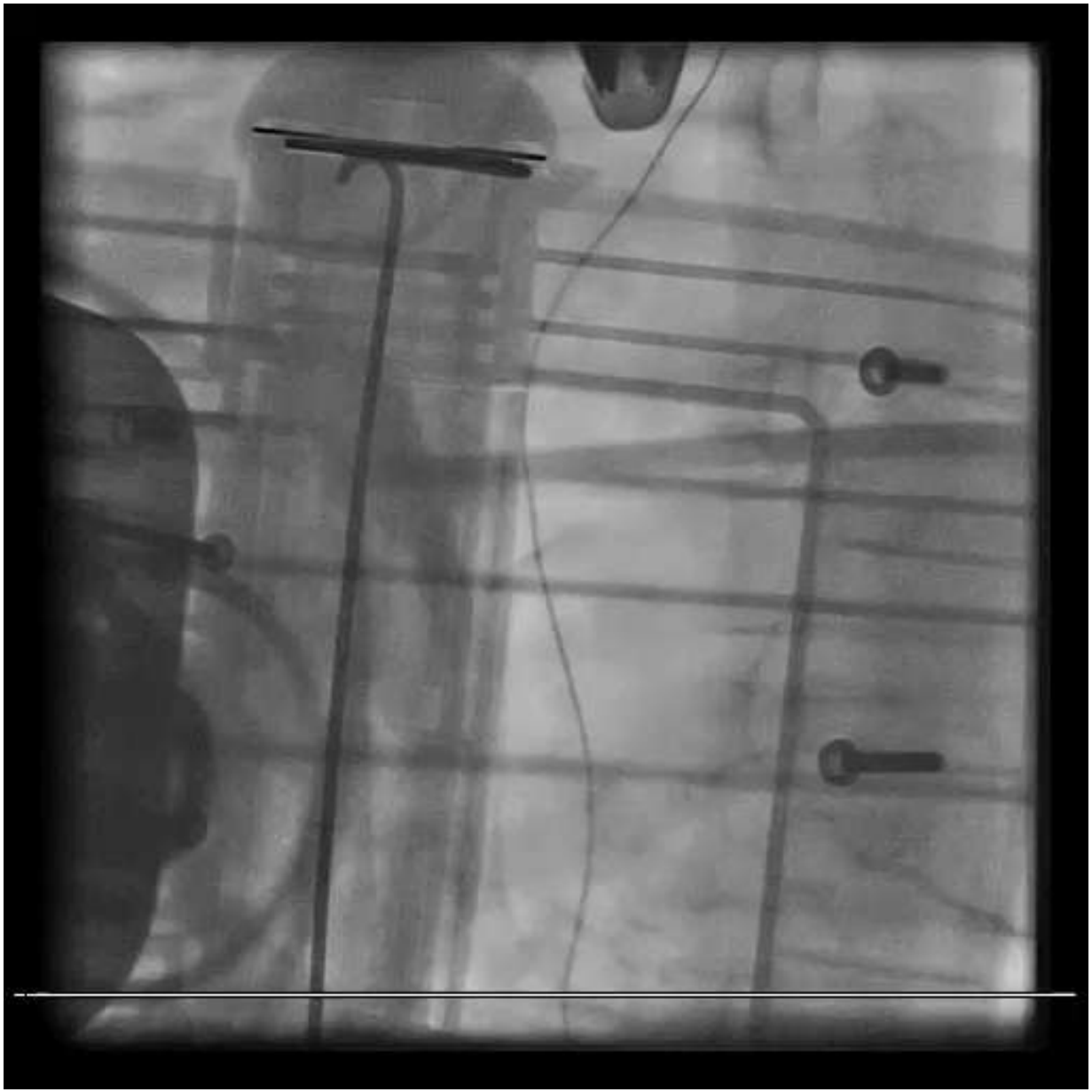
1.Généreux, P., et al. (2012). *J Am Coll Cardiol, 59*(24).
2.Mehta, S.R., et al. (2019). *N Engl J Med, 381*(15):, 1411-1421.
3.Bainey, K.R., et al., (2020) *JAMA Cardiol.*

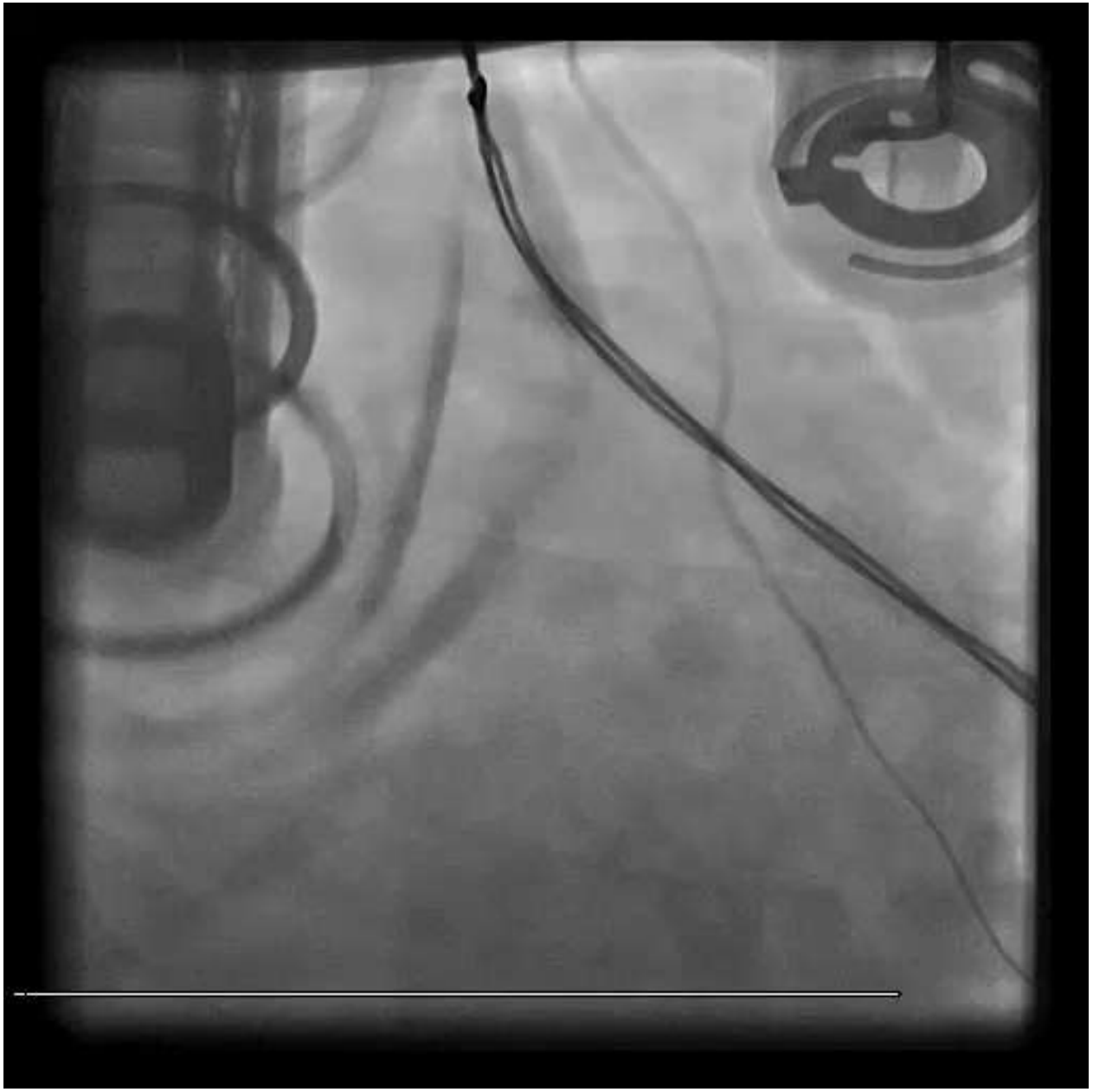
Caso clínico #1

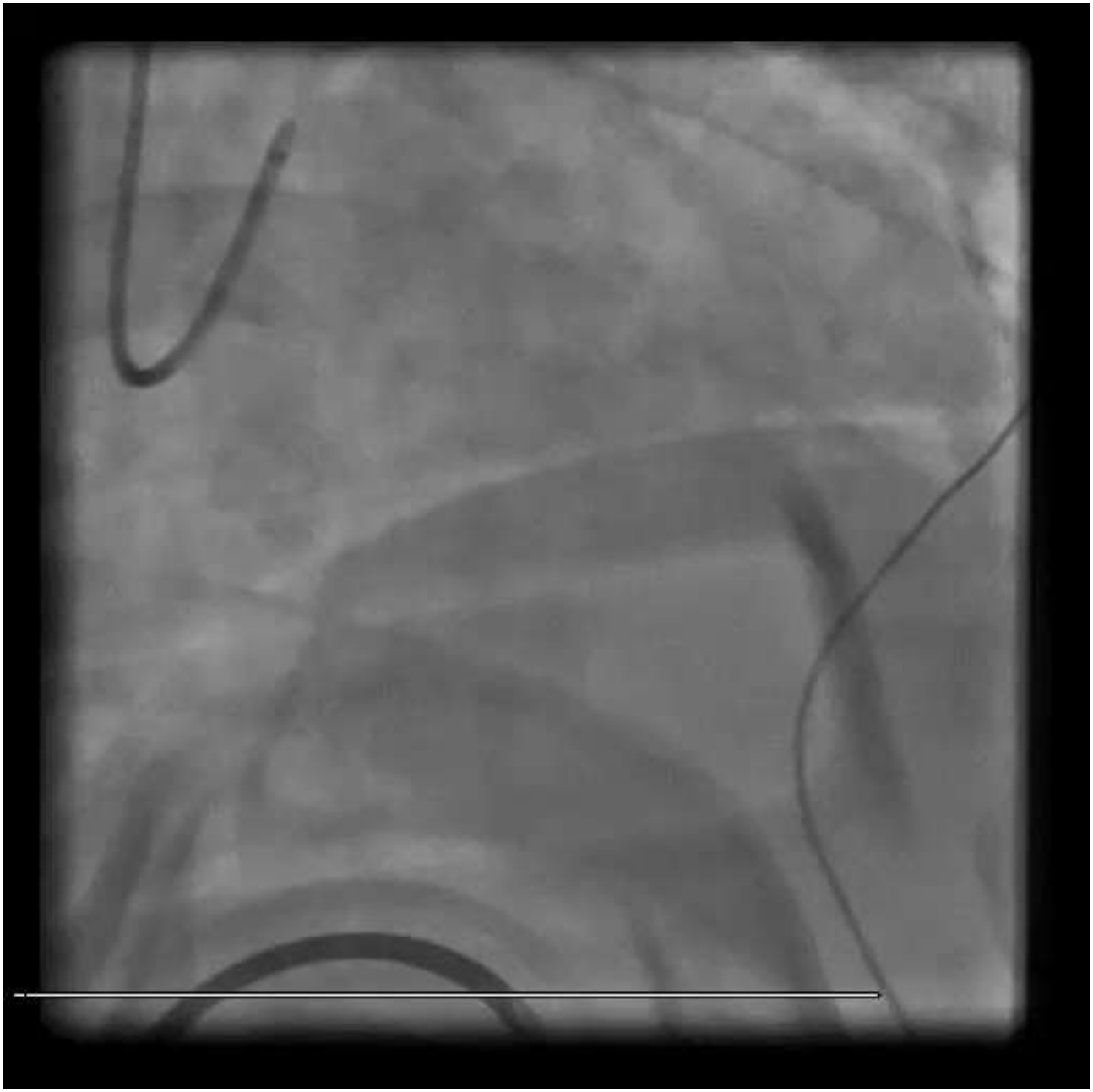
- Hombre, 43 años, parada cardiaca presenciada, RCP inmediato.
- Sin antecedentes conocidos.
- Tiempo desde parada cardiaca a Cath-lab 25min.

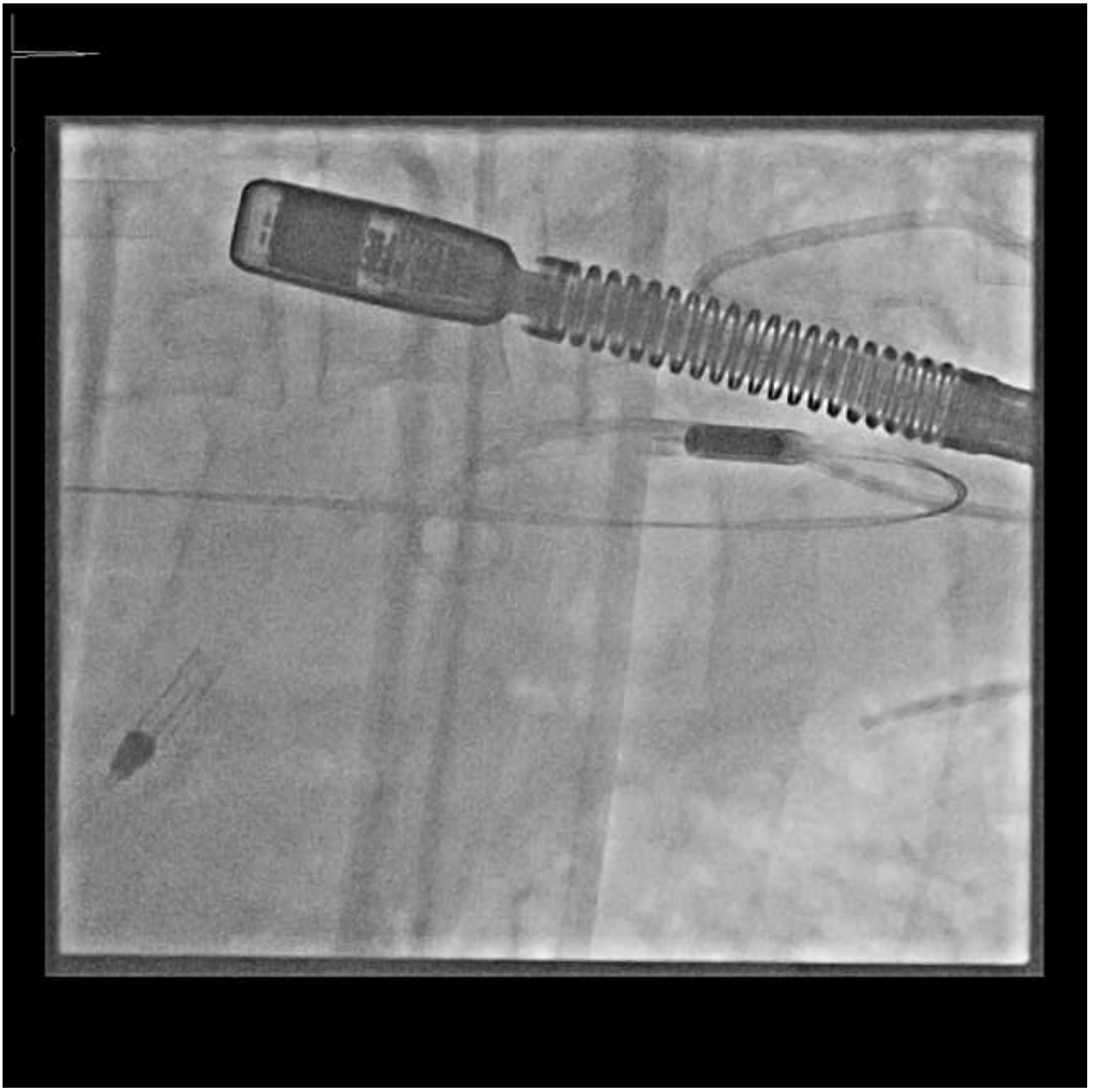

85
V
5
10
15

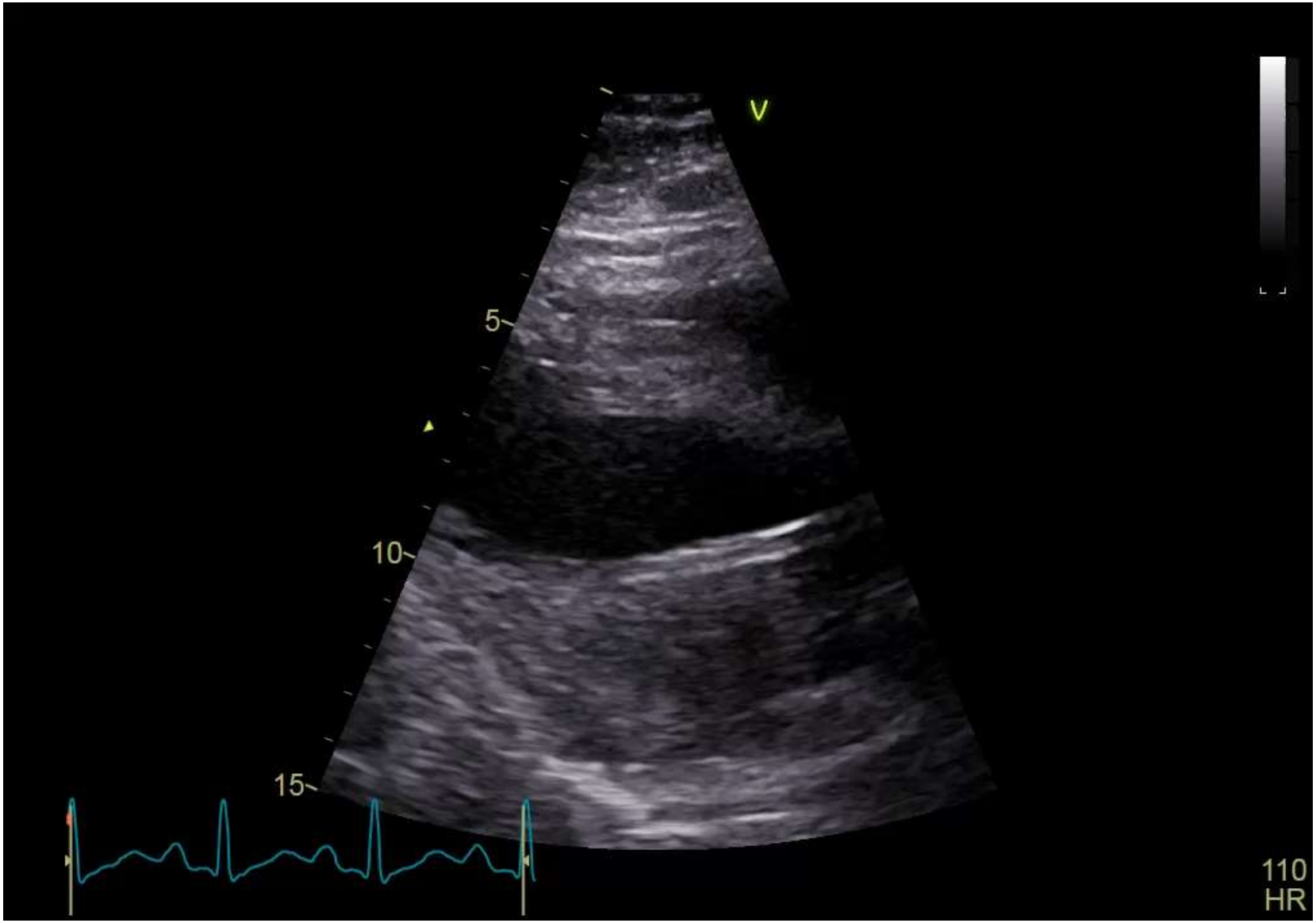

0
V
5
10
15

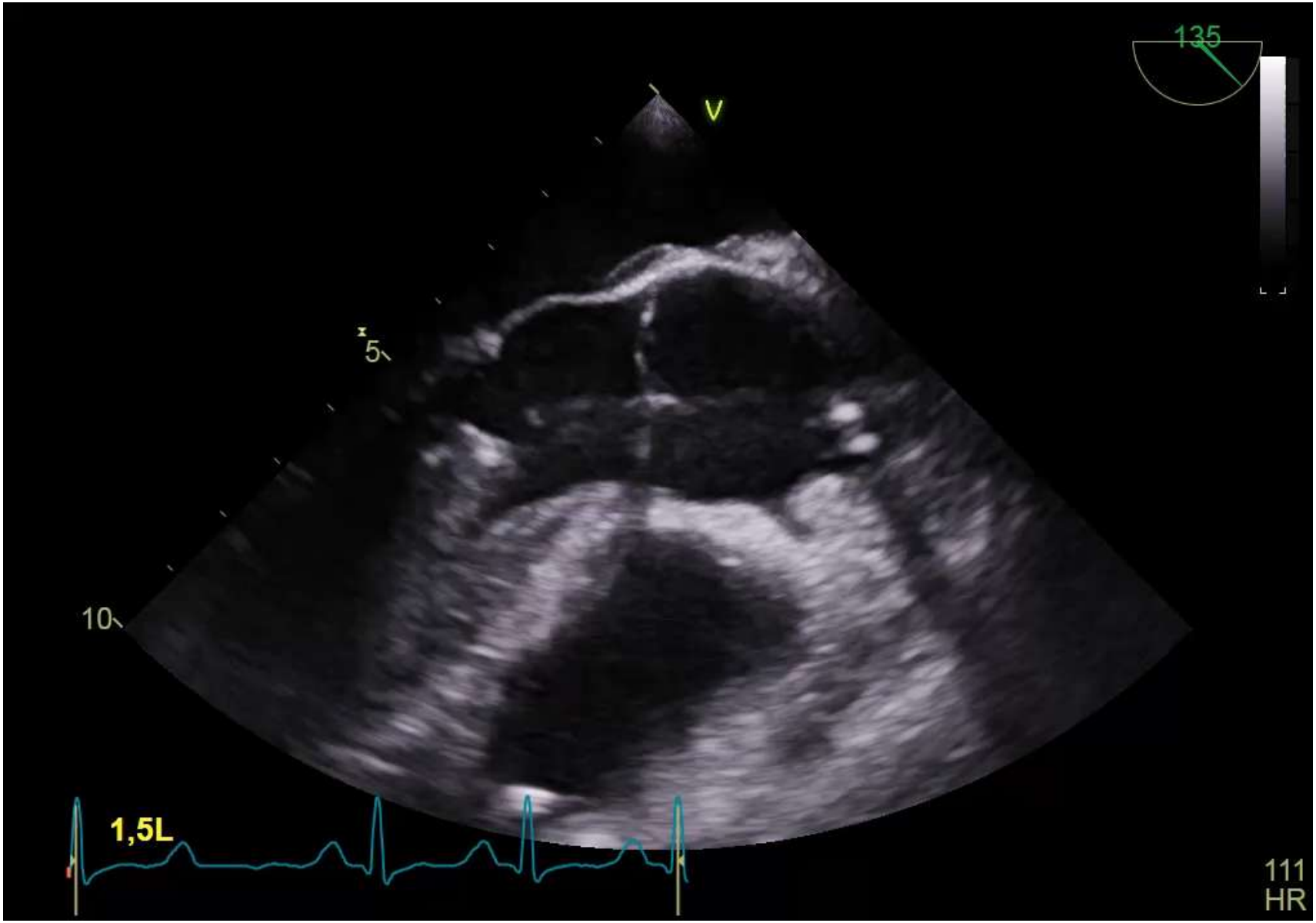




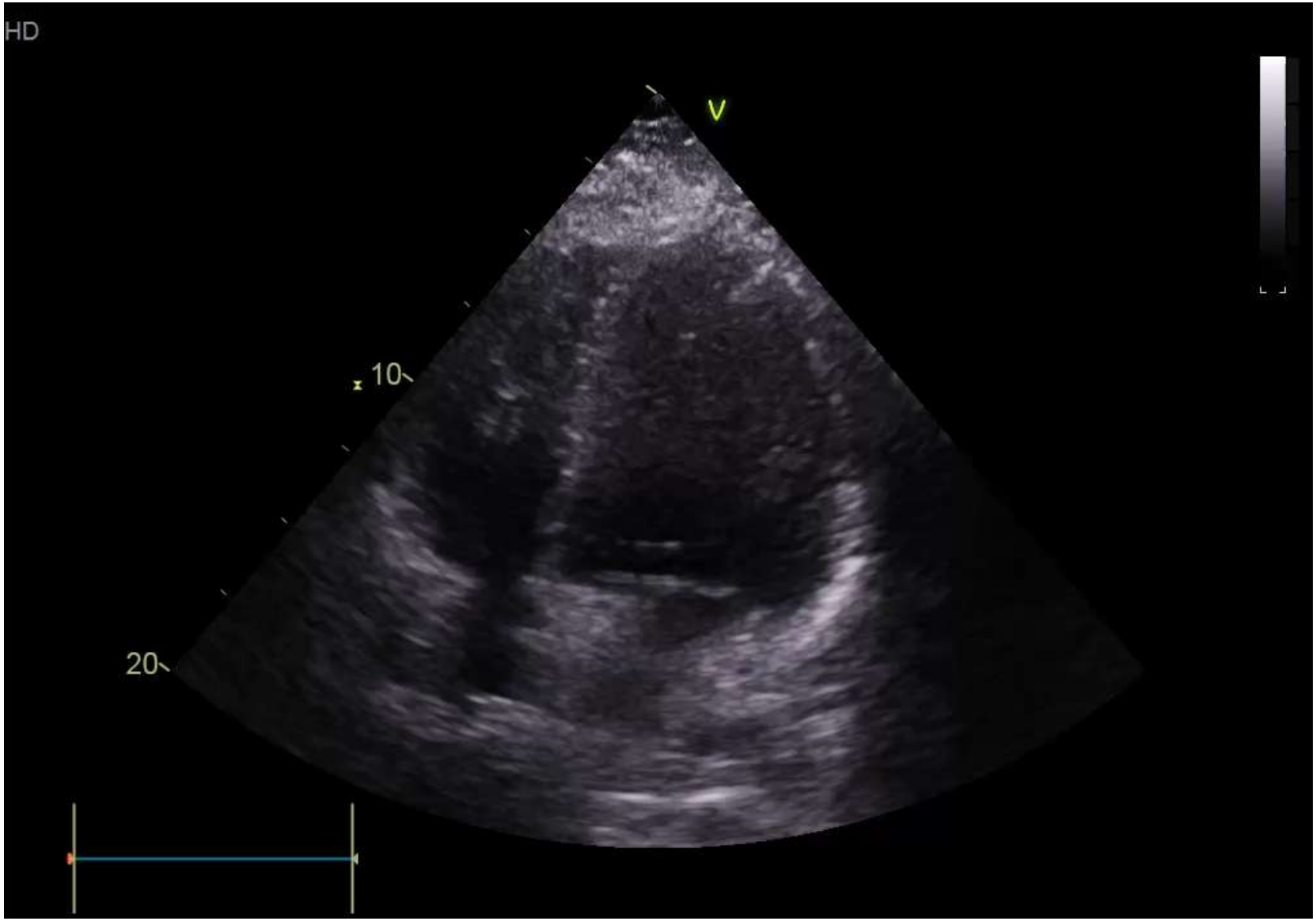


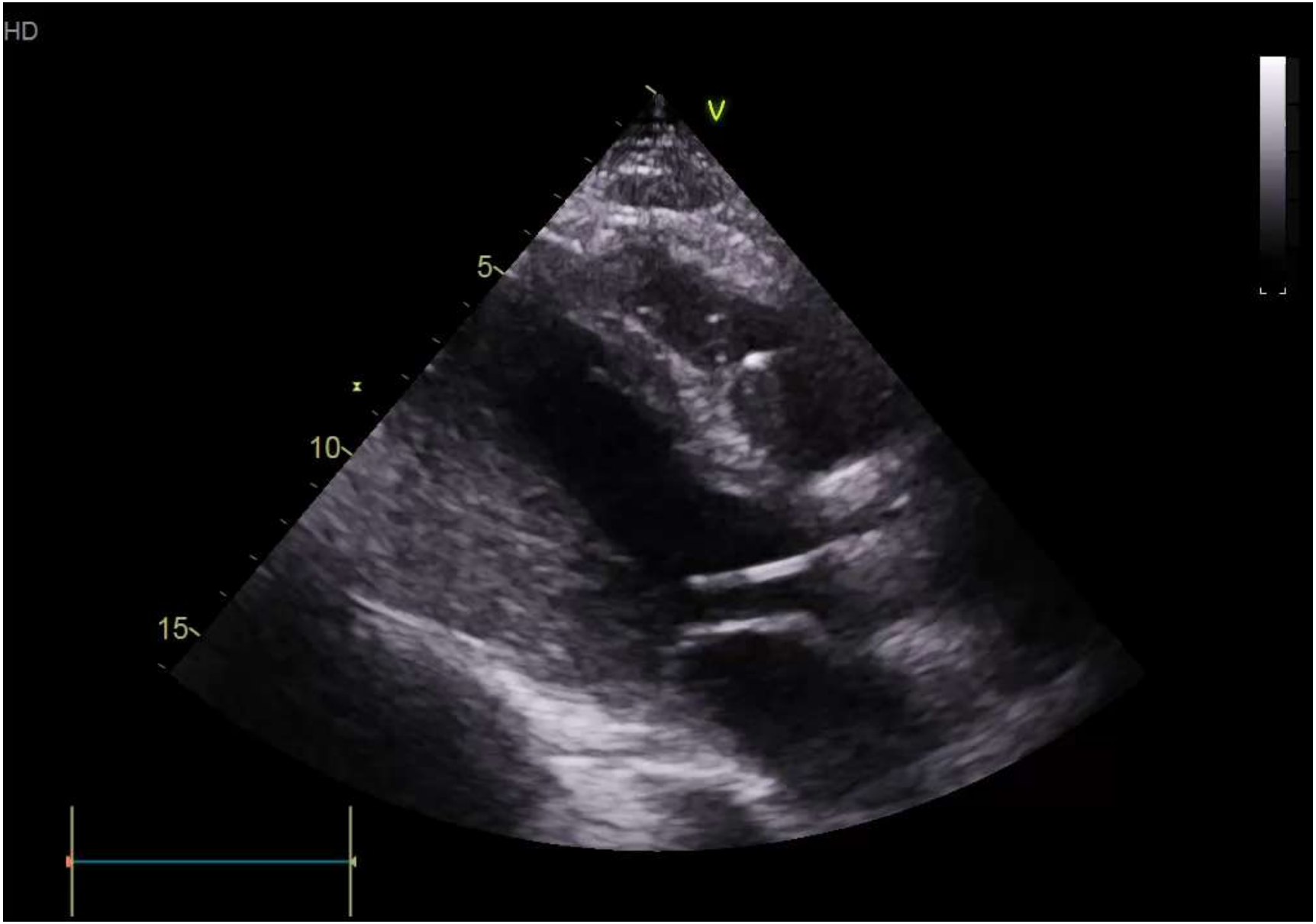



V
5
10
15
110
HR


135
V
5
10
1,5L
111
HR

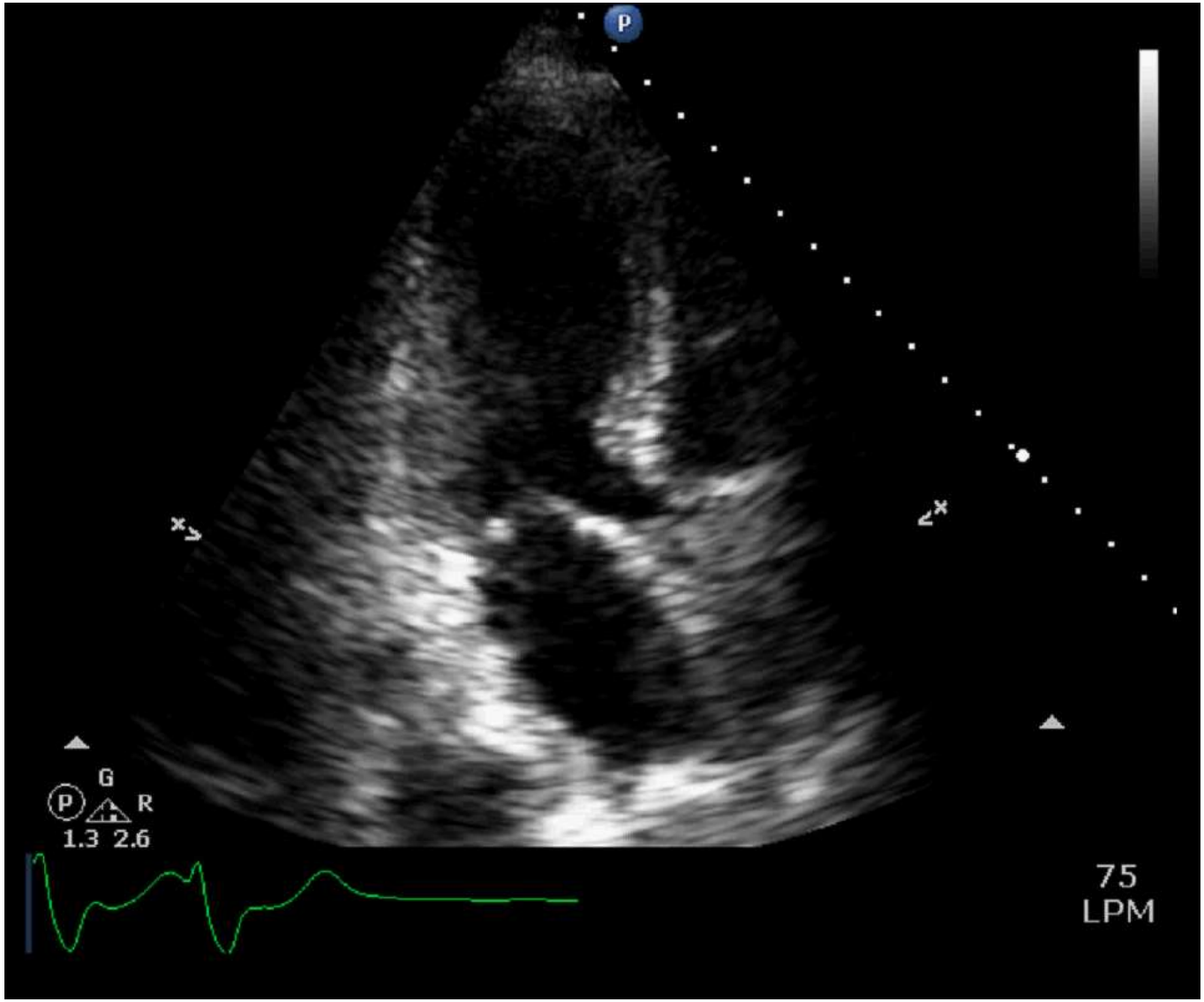
- Dx INICIAL, SICASEST.
- Dx final, miocarditis post vacuna COVID.
- + Impella (60min).
- Impella + ECMO (3 dias).
- ECMO (6 dias).
- UTI total (14 dias).
- Recuperación y FEVI normal.

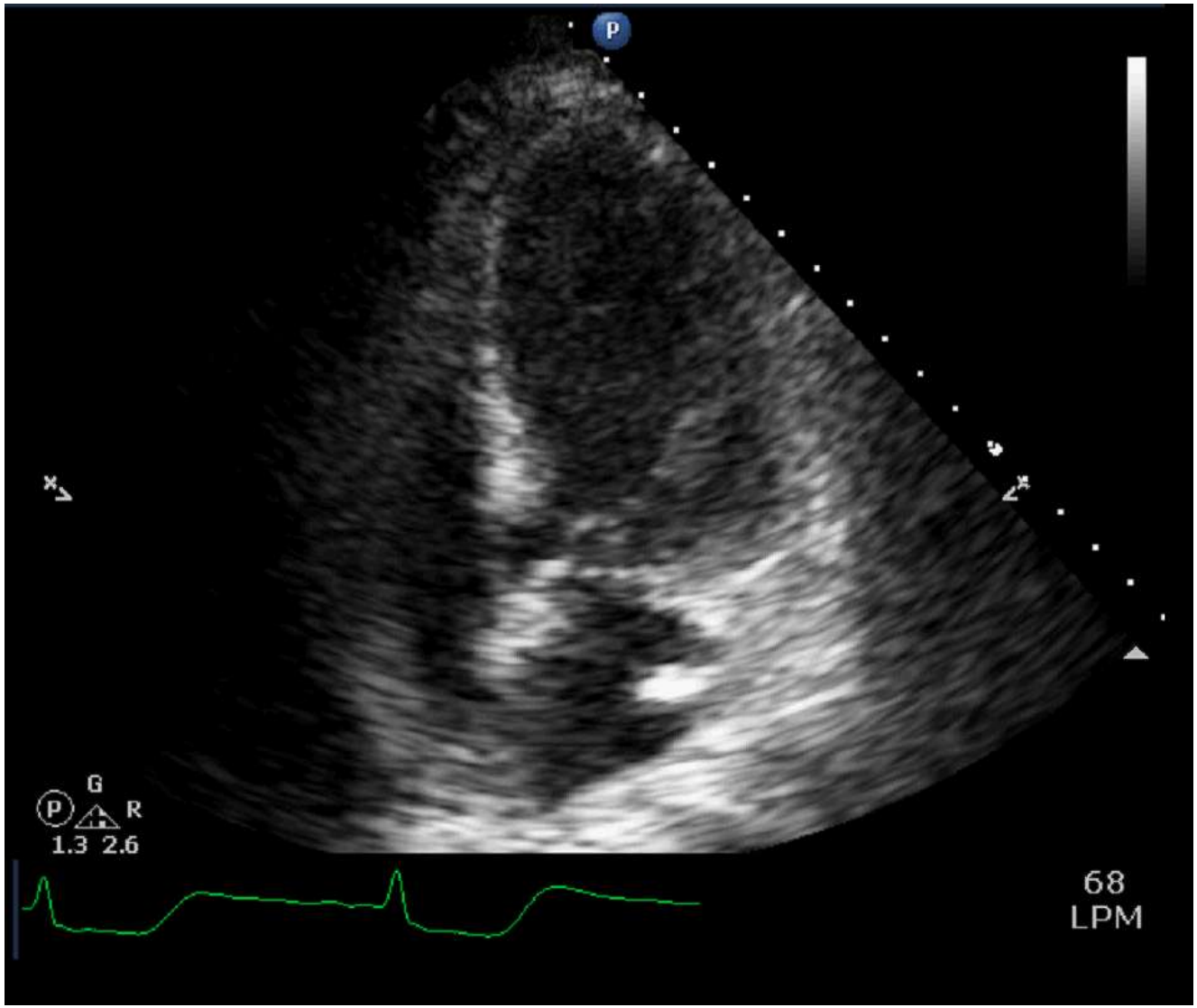

HD
V
10
20

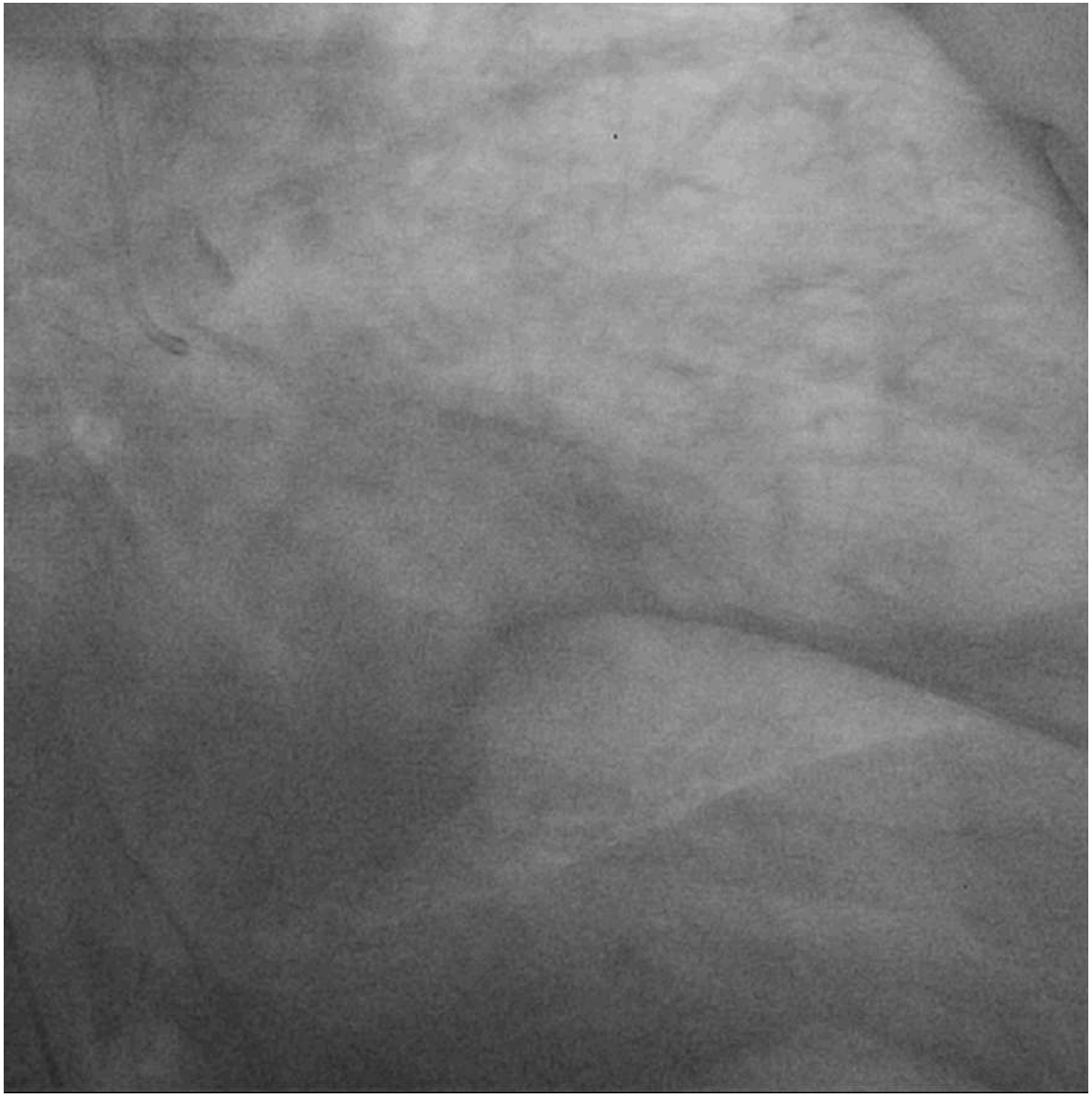

HD
V
5
10
15

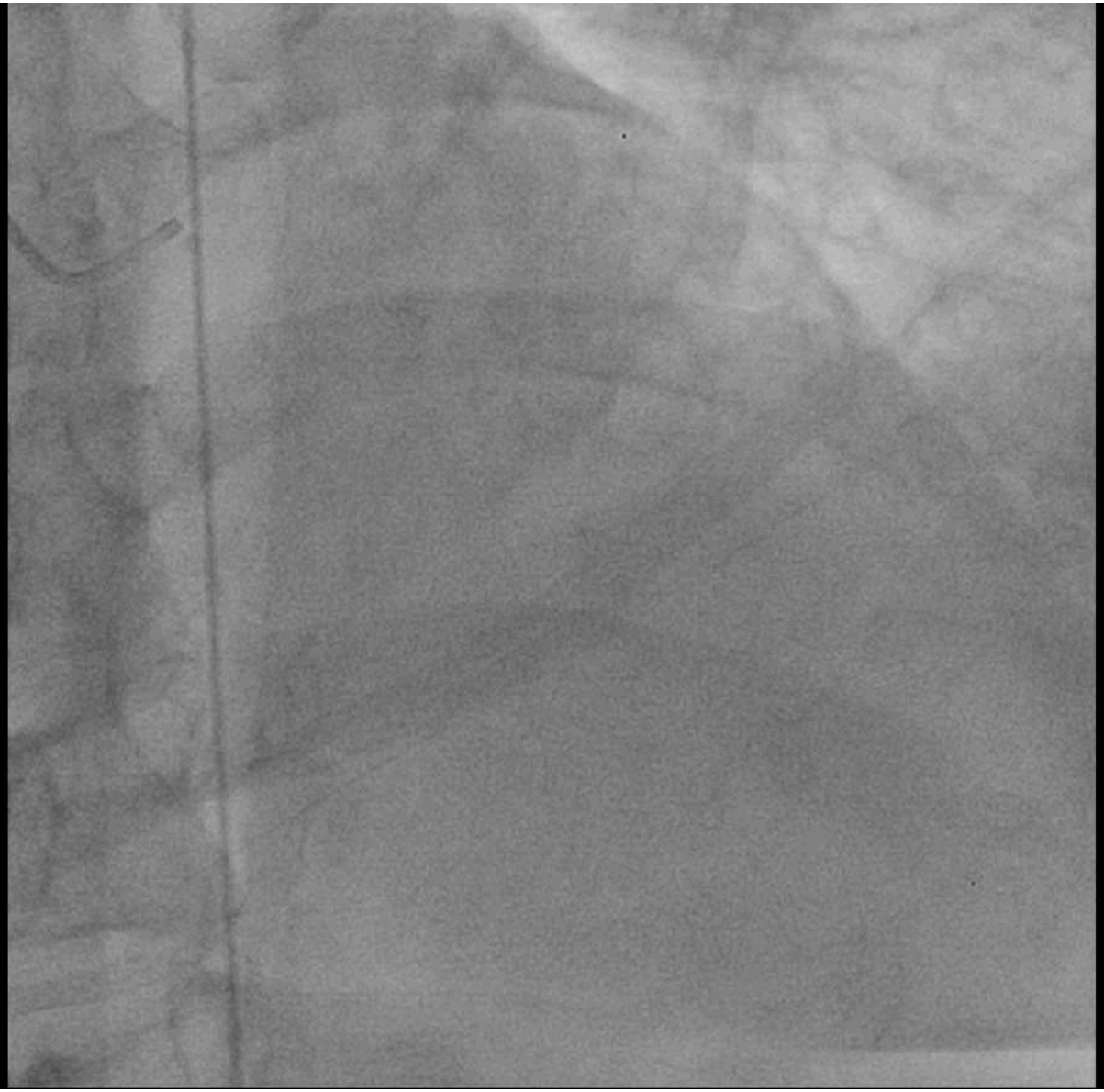
Caso clínico #2

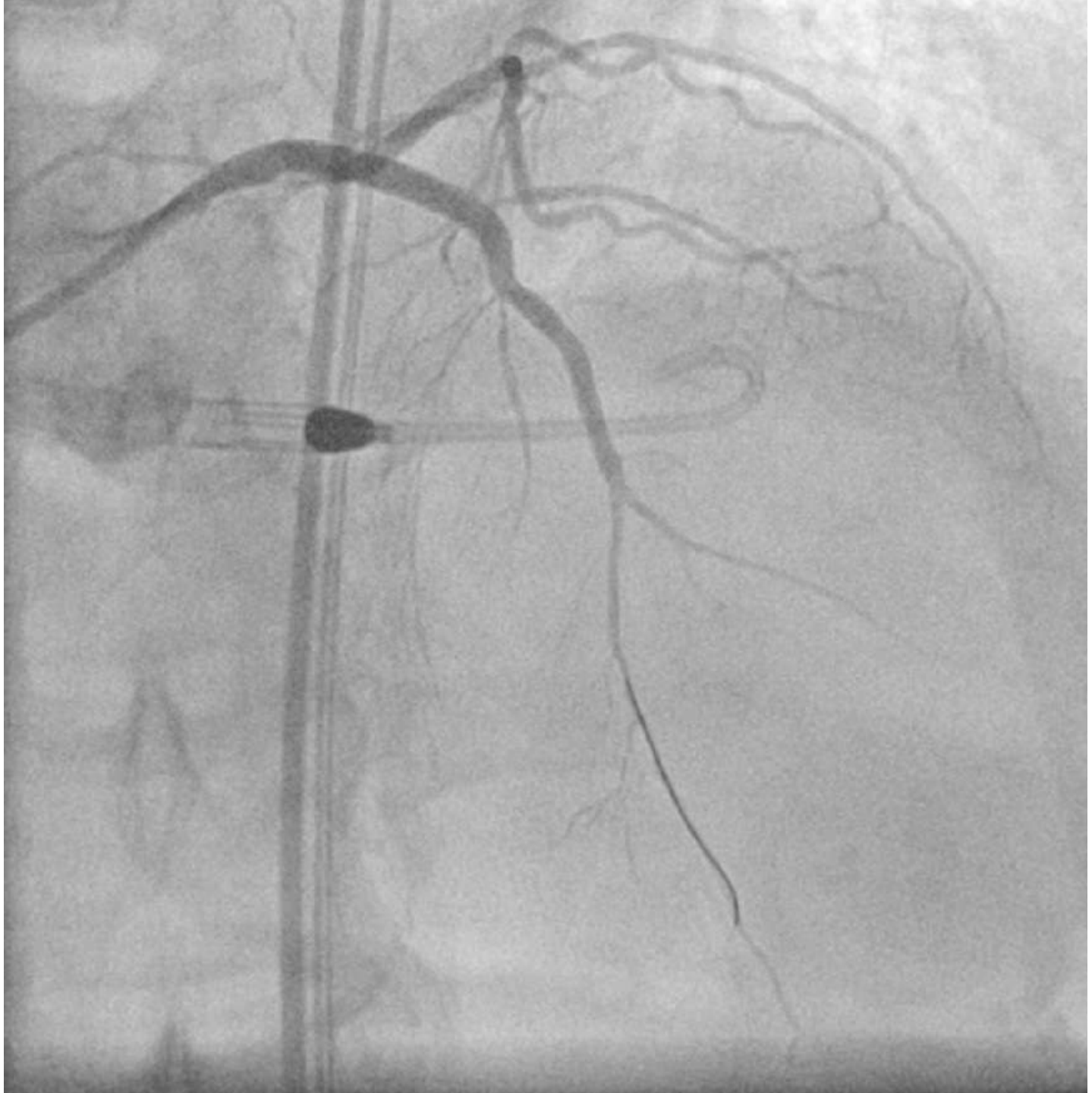
- Mujer de 58 años, IAM anterior sin terapia de reperfusión 2 días previos a su ingreso.
- Ingresó por angina posinfarto, TV sostenida estable que no mejoró con AMIODARONA y lidocaina, creatinina 2.8.
- 2 descargas de 150 joules.

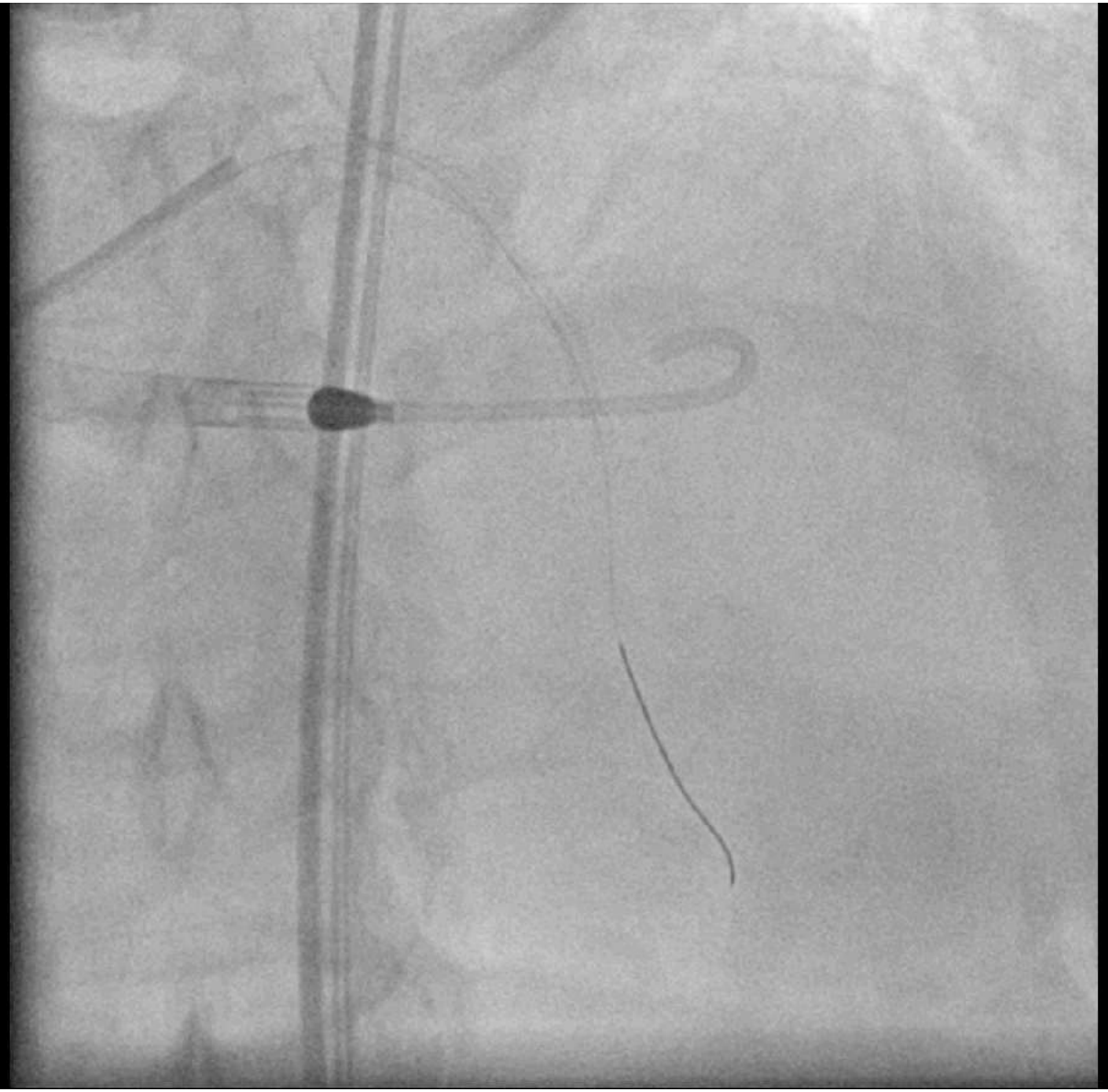

P
G
P
R
1.3 2.6
75
LPM


P
G
P
R
1.3 2.6
68
LPM










180
-20
Señales de colocación
Aorta
(mmHg)
100/62
(71)
VI
134/11
10 s
1400
400
Corriente del motor
(mA)
962/808
(879)
10 s
Flujo del Imp.
4.3 Máx
3.2 Mín
3.7
L/min
Purgar sistema
Flujo de purga: 11.4 ml/h
Presión de purga: 488 mmHg
Gasto cardiaco: -- L/min
Gasto pot. card.: -- Vatios


180
-20
Señales de colocación
Aorta (mmHg)
63/59
(61)
VI (mmHg)
91/22
10 s
CONTROL DE FLUJO
P-9
MOSTRAR
1400
400
Corriente del motor (mA)
951/850
(875)
10 s
MENÚ DE PURGA
MENÚ
Flujo del Imp.
4.3 Máx
3.5 Mín
3,8 L/min
Purgar sistema
Flujo de purga: 11.4 ml/h
Presión de purga: 479 mmHg
Gasto cardiaco: -- L/min
Gasto pot. card.: -- Vatios

ACC.24

- Percutaneous Transvalvular Micro-axial Flow Pump in Infarct Related Cardiogenic Shock.

Results of The DanGer-Shock Trial

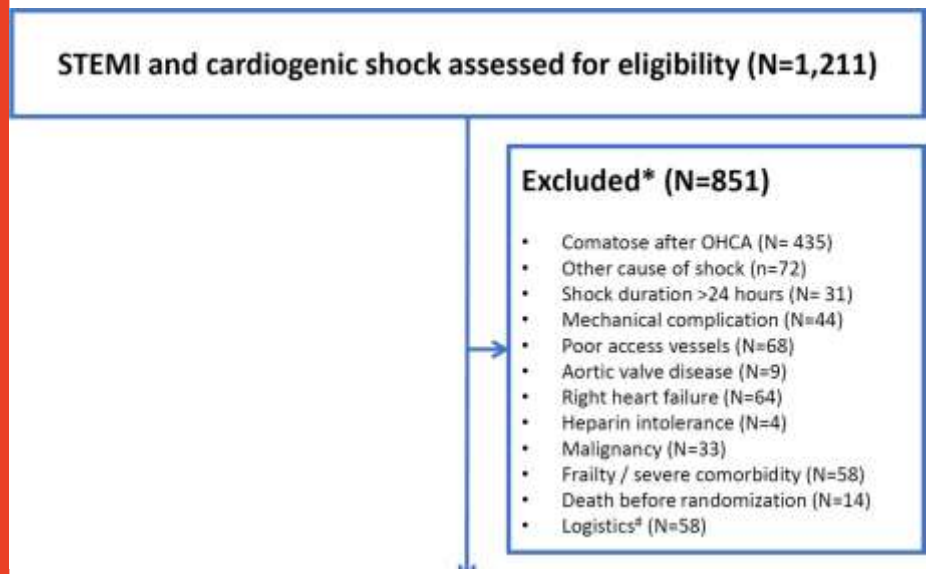
Jacob Eifer Møller

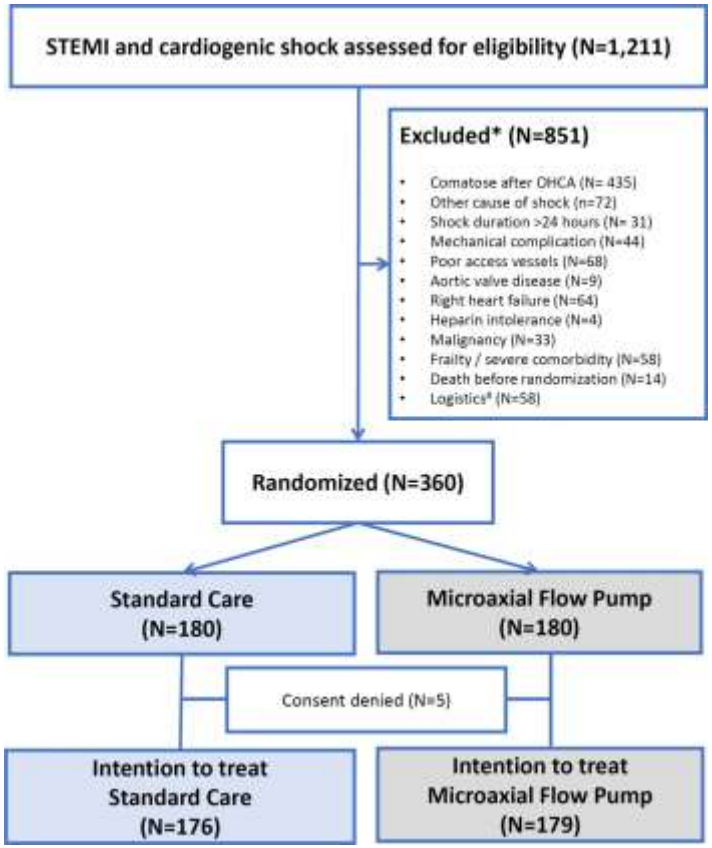
Professor MD PhD DMSc

Odense University Hospital and Rigshospitalet, Denmark

Jacob.moeller1@rsyd.dk

Trial Flow


STEMI and cardiogenic shock assessed for eligibility (N=1,211)
Excluded* (N=851)
Comatose after OHCA (N= 435)
Other cause of shock (n=72)
Shock duration >24 hours (N= 31)
Mechanical complication (N=44)
Poor access vessels (N=68)
Aortic valve disease (N=9)
Right heart failure (N=64)
Heparin intolerance (N=4)
Malignancy (N=33)
Frailty / severe comorbidity (N=58)
Death before randomization (N=14)
Logistics[a] (N=58)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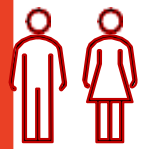
Aortic valve disease (N=9)
Right heart failure (N=64)
Heparin intolerance (N=4)
Malignancy (N=33)
Frailty / severe comorbidity (N=58)
Death before randomization (N=14)
Logistics[a] (N=58)
Randomized (N=360)
Standard Care (N=180)
Microaxial Flow Pump (N=180)
Consent denied (N=5)
Intention to treat Standard Care (N=176)
Intention to treat Microaxial Flow Pump (N=179)

Patients characteristics – N=355



Median 69 years
79% male

Median lactate 4.5 mmol/L

72% LAD or LM culprit
72% Multi vessel disease

Median 4 hrs from onset of STEMI symptoms to randomization

84% randomized in cath lab

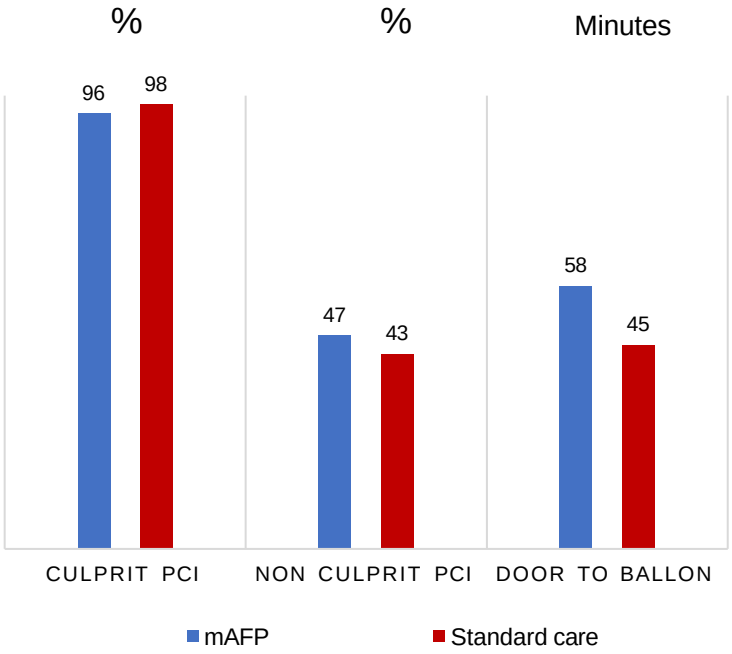
Median LVEF 25%

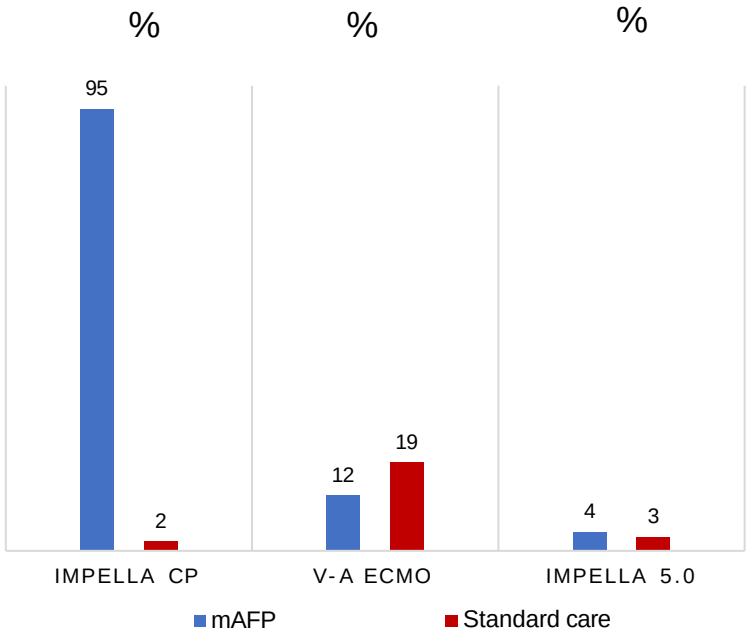
55% SCAI class C
45% SCAI class D or E

Median systolic BP
82 mmHg

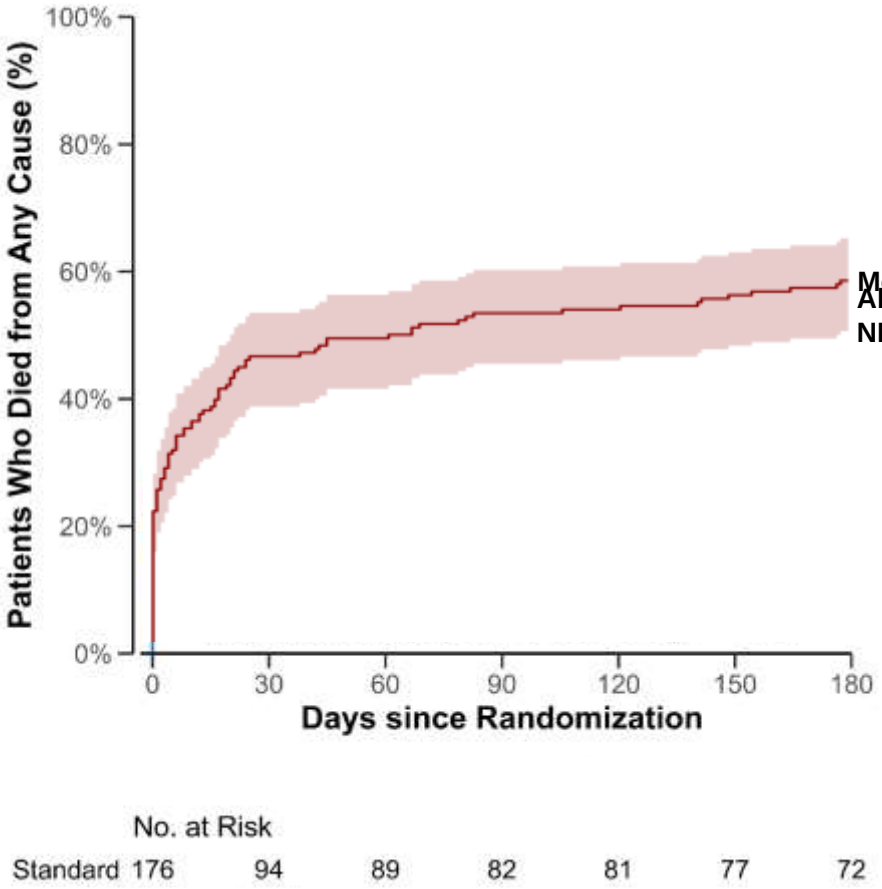
Revascularization

Temporary MCS





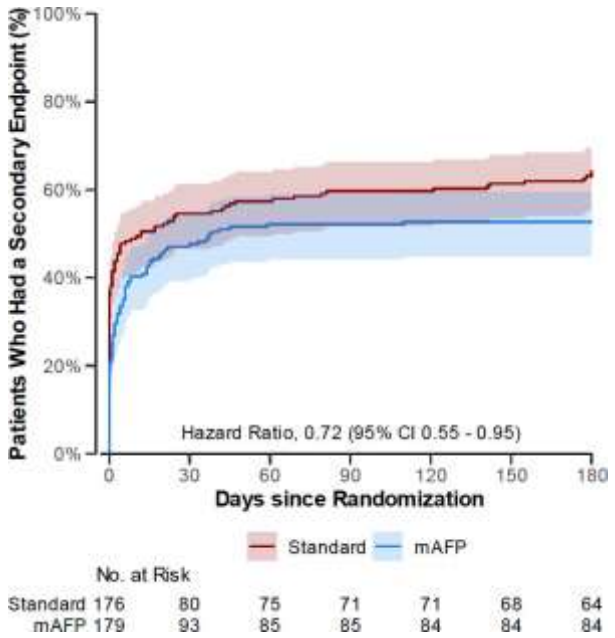
Primary end point

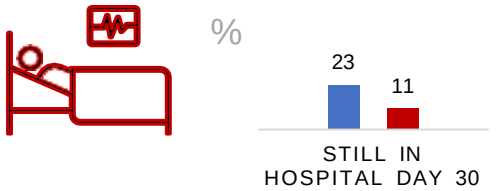


Mortality rate at 6 months 59%
Absolute 13% reduction
NNT 8

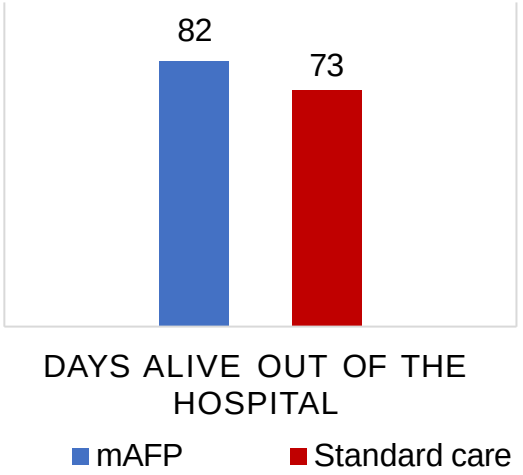
Escalation to short or longterm MSC, HTX or Death from any cause at 180 days

Secondary end points

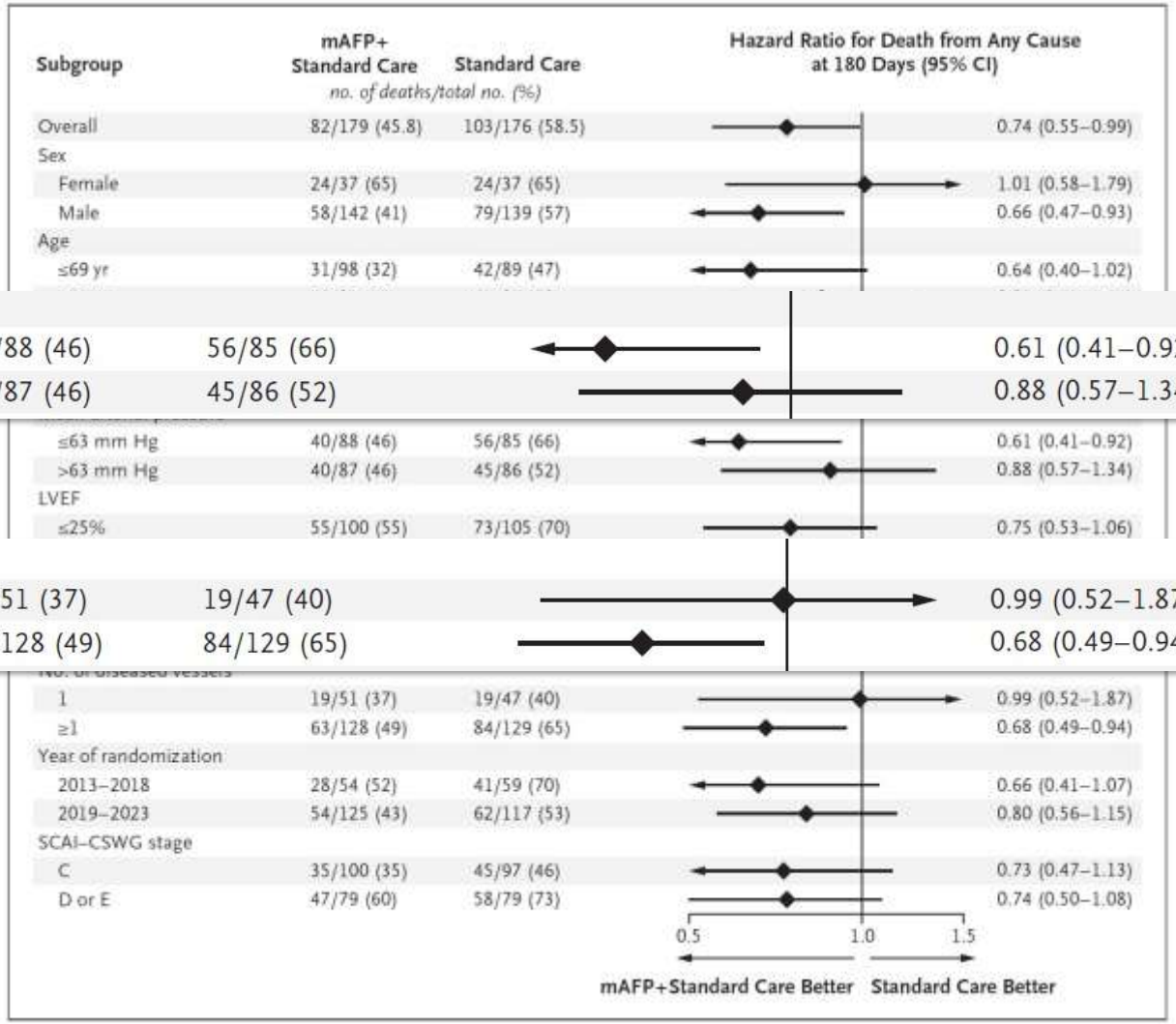




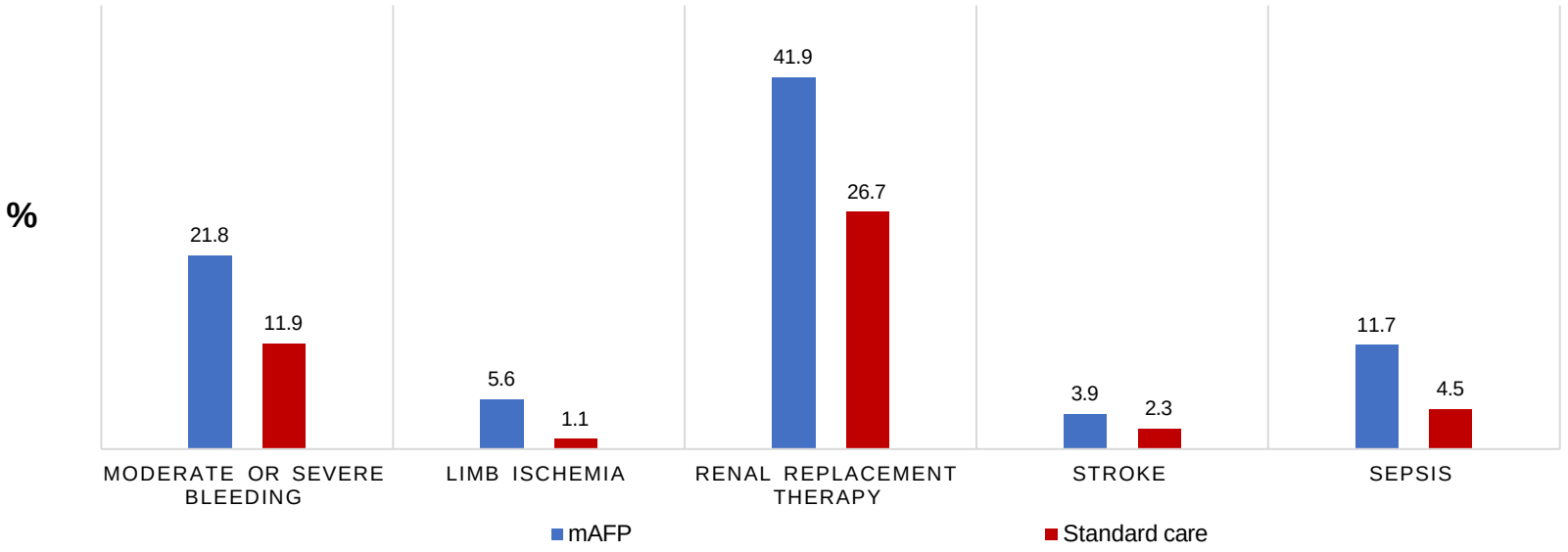
Mean difference 8 days (95%CI -8 to 25)



Prespecified Subgroups



Adverse events



Conclusion

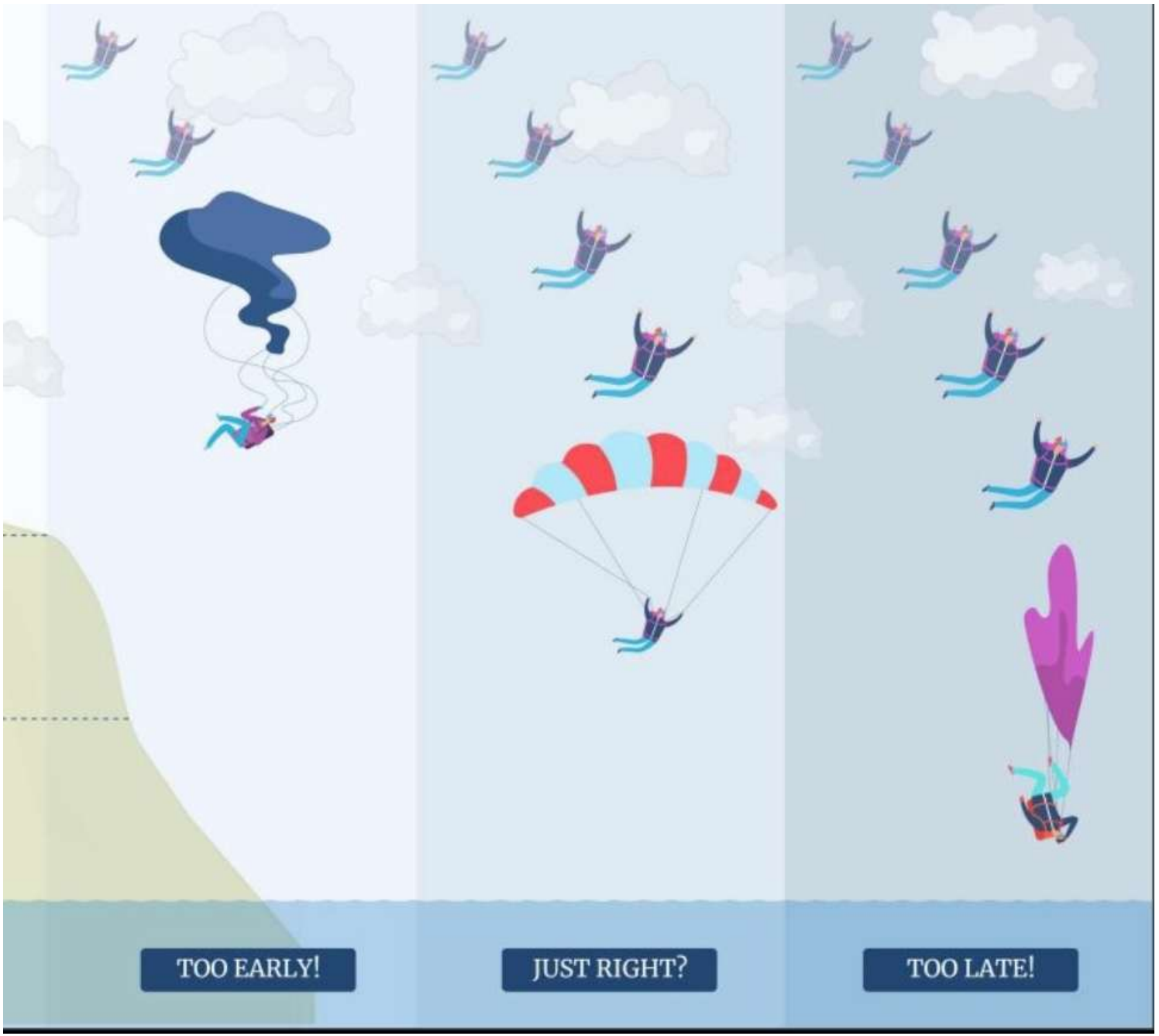
- The routine use of a mAFP on top of standard care reduced death from any cause in patients with STEMI and cardiogenic shock.
- This was associated with an increased risk of adverse events.
- The study results can not be extrapolated to other causes of cardiogenic shock including OHCA, NonSTEMI and nonischemic cardiogenic shock

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Microaxial Flow Pump or Standard Care in Infarct-Related Cardiogenic Shock

J.E. Møller, T. Engstrøm, L.O. Jensen, H. Eiskjær, N. Mangner, A. Polzin, P.C. Schulze, C. Skurk, P. Nordbeck, P. Clemmensen, V. Panoulas, S. Zimmer, A. Schäfer, N. Werner, M. Frydland, L. Holmvang, J. Kjærgaard, R. Sørensen, J. Lønborg, M.G. Lindholm, N.L.J. Udesen, A. Junker, H. Schmidt, C.J. Terkelsen, S. Christensen, E.H. Christiansen, A. Linke, F.J. Woitek, R. Westenfeld, S. Möbius-Winkler, K. Wachtell, H.B. Ravn, J.F. Lassen, S. Boesgaard, O. Gerke, and C. Hassager, for the DanGer Shock Investigators*


TOO EARLY!
JUST RIGHT?
TOO LATE!

Entonces…

- Impella CP en estadio C-D.
- ECMO en estadio D de manera temprana.
- Valorar descarga del VI.
- **Uso de SWAN GANZ.**
- Seguir tratamiento diurético.
- Evitar intubación.
- Si hay intubación realizar extubación temprana aun con ECMO.

Conclusiones.

- El uso de asistencias ventriculares es un pilar del tratamiento del choque cardiogénico.
- **Es importante evaluar su uso TEMPRANO.**
- Catéter de Swan Ganz.
- **Considerar escalamiento.**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