31st Annual Scientific Congress
Hong Kong College of Cardiology

An experience in cardiogenic shock
A-case review

Dr. Vincent Kuok-wun LAM

Centro Hospitalar Conde S. Januário, Macau

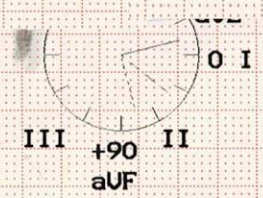
No conflict of interest

Background

- 67 year-old male
- Risk for CAD: age, gender, smoker, HTN, DM, dyslipidemia
- Hx of Proteinuria and hematuria, follow-up in Nephrology OPD
- Presented to ER at 09:22 on 2022/8/30 due to persistent chest pain (02:00) > 6hrs with cold sweating. Nausea and vomiting

Measurement Results:

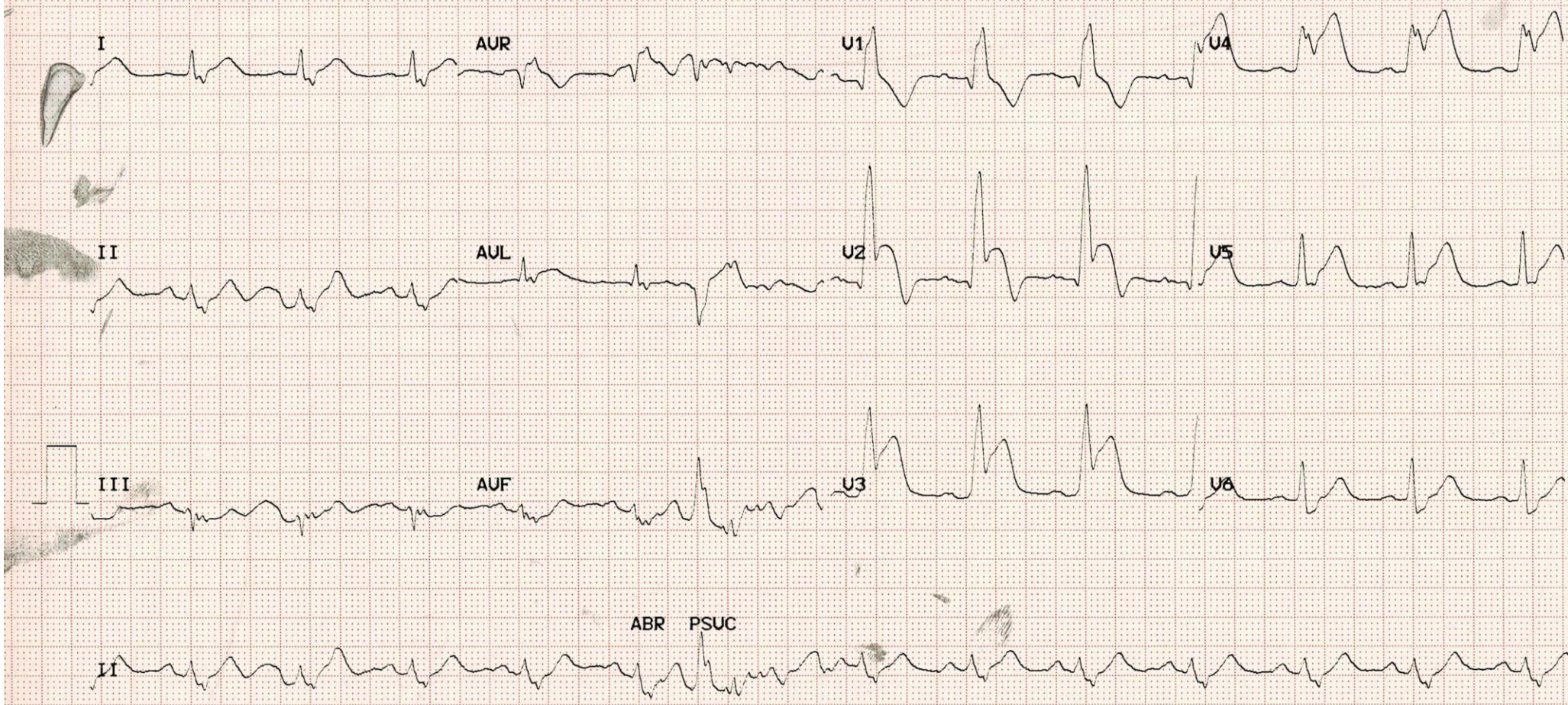
QRS	:	154	ms
QT/QTcB	: 430 /	485	ms
PR	:	176	ms
P	:	116	ms
RR/PP	: 786 /	785	ms
P/QRS/T	: 75/ -15/	40	degrees
QTD/QTcBD:	72 /	81	ms
Sokolow	:		mV
NK	:	9	



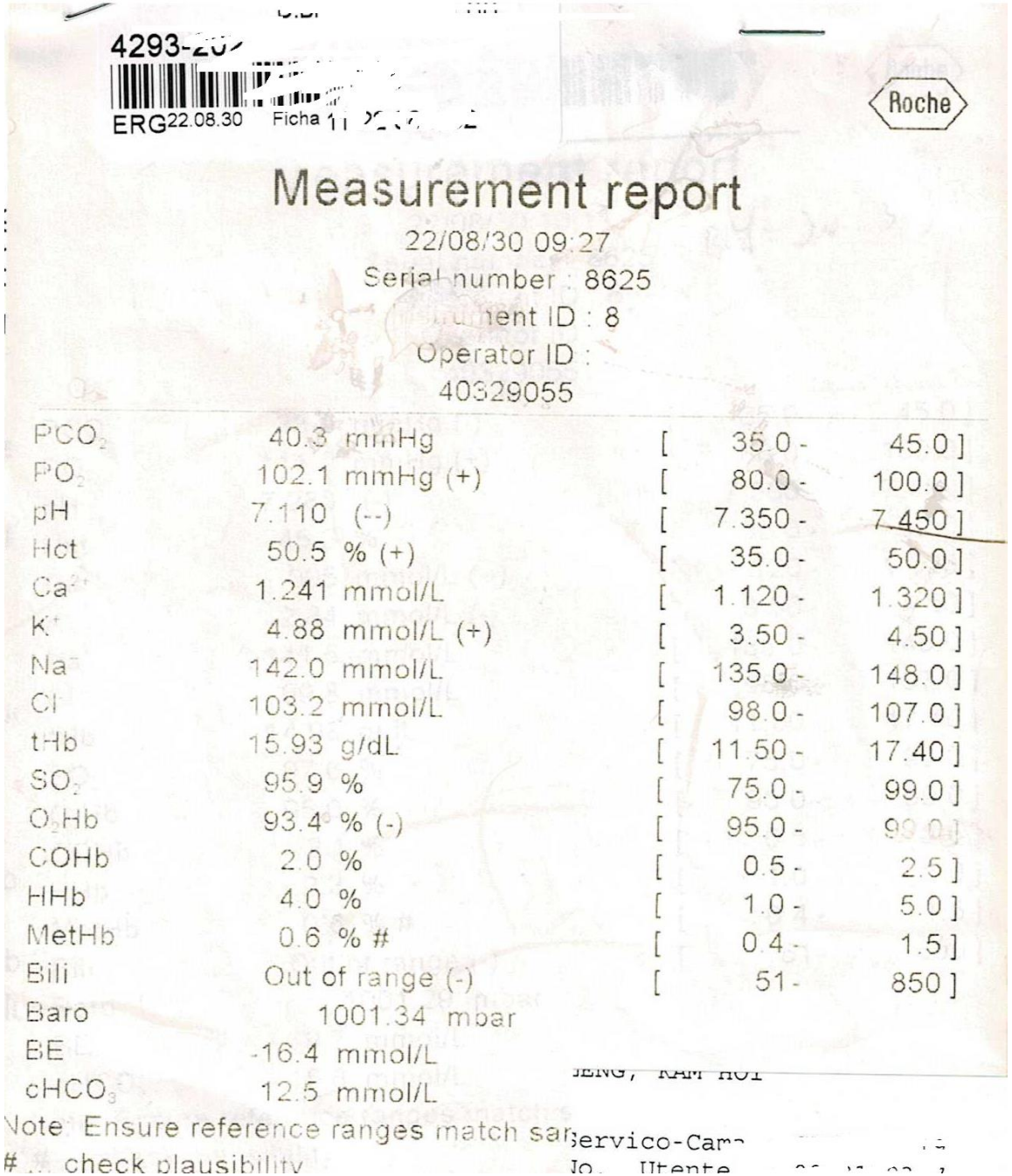
ɔretation:

ɔly MI (inferior)
.robably acute MI (anterior)
complete right bundle branch block
occasional premature supraventr. complexes
low QRS amplitudes
prolonged QT
probably abnormal ECG

Unconfirmed report.



- Aspirin 300mg chew given and cardiac monitoring
- On arrival of Cath Lab, Bipap support given
- V-Scan: poor LVEF
- Developed recurrent VF, total Defibrillation 200J x5 times and CRP was performed.
- Adrenaline 1mg IV X 4 times
- High degree AVB monitoring and atropine 0.6mg IV X 4 times given
- Patient was intubated with MV support.
- Dopamine 10mcg/kg/min IVF, Amiodarone 600mg IV



4293-20

ERG22.08.30 Ficha

Roche

Measurement report

22/08/30 09:27

Serial number : 8625

ient ID : 8

Operator ID :

40329055

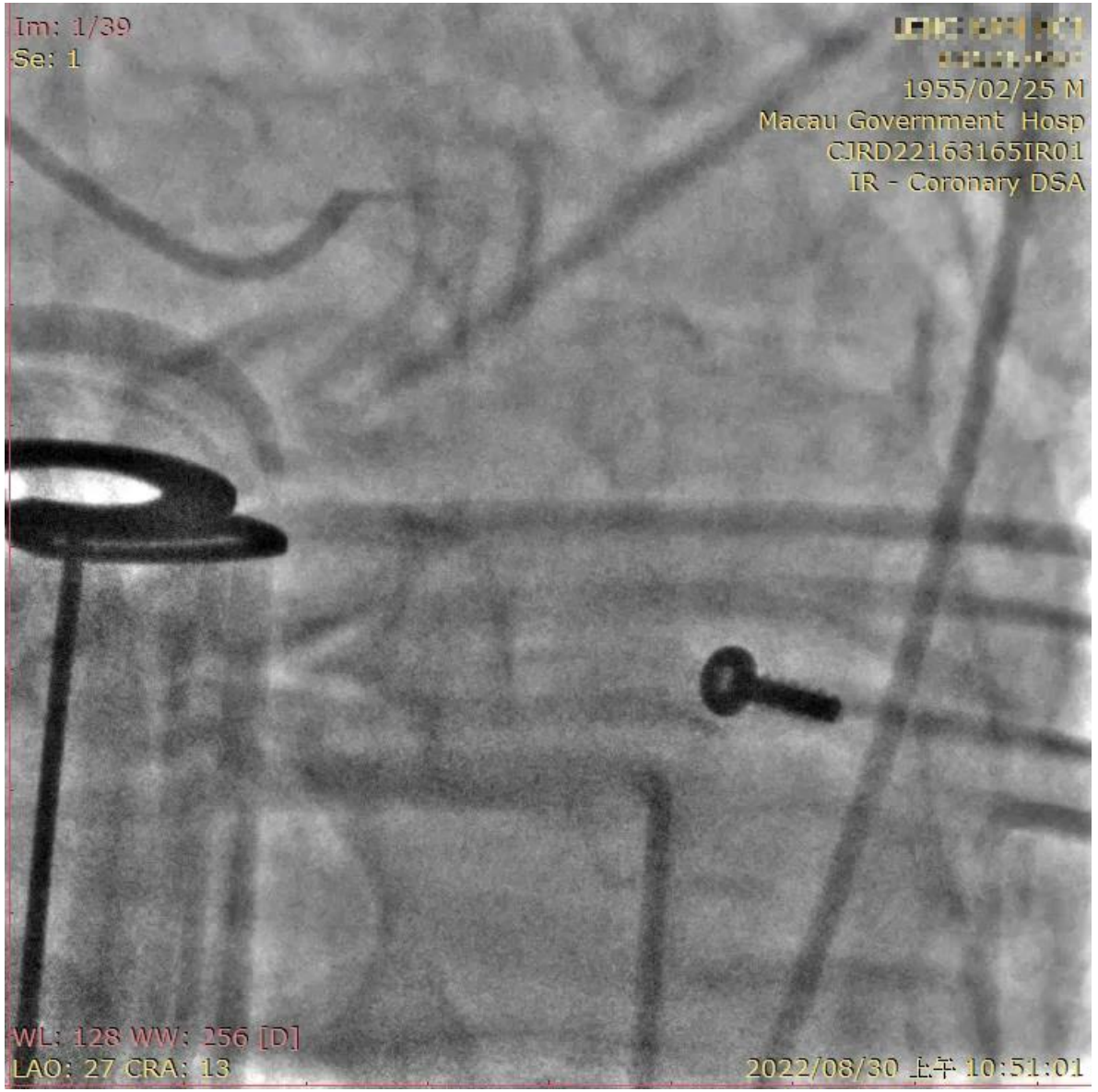
PCO_2	40.3 mmHg	[35.0 -	45.0]
PO_2	102.1 mmHg (+)	[80.0 -	100.0]
pH	7.110 (--)	[7.350 -	7.450]
Hct	50.5 % (+)	[35.0 -	50.0]
Ca^{2+}	1.241 mmol/L	[1.120 -	1.320]
K^+	4.88 mmol/L (+)	[3.50 -	4.50]
Na^+	142.0 mmol/L	[135.0 -	148.0]
Cl	103.2 mmol/L	[98.0 -	107.0]
tHb	15.93 g/dL	[11.50 -	17.40]
SO_2	95.9 %	[75.0 -	99.0]
O_2Hb	93.4 % (-)	[95.0 -	99.0]
COHb	2.0 %	[0.5 -	2.5]
HHb	4.0 %	[1.0 -	5.0]
MetHb	0.6 % #	[0.4 -	1.5]
Bili	Out of range (-)	[51 -	850]
Baro	1001.34 mbar		
BE	-16.4 mmol/L		
$cHCO_3$	12.5 mmol/L		

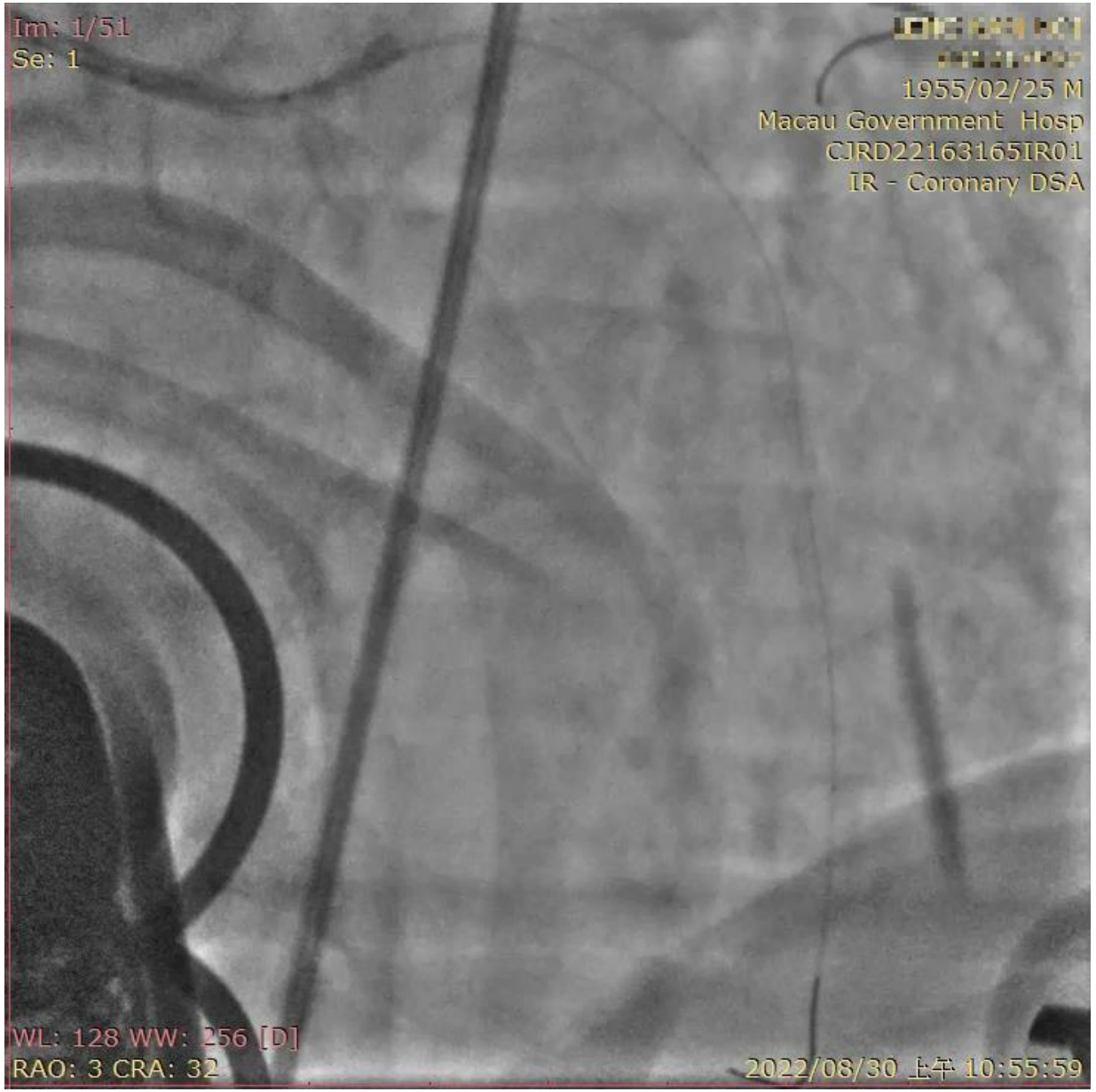
Note: Ensure reference ranges match sa

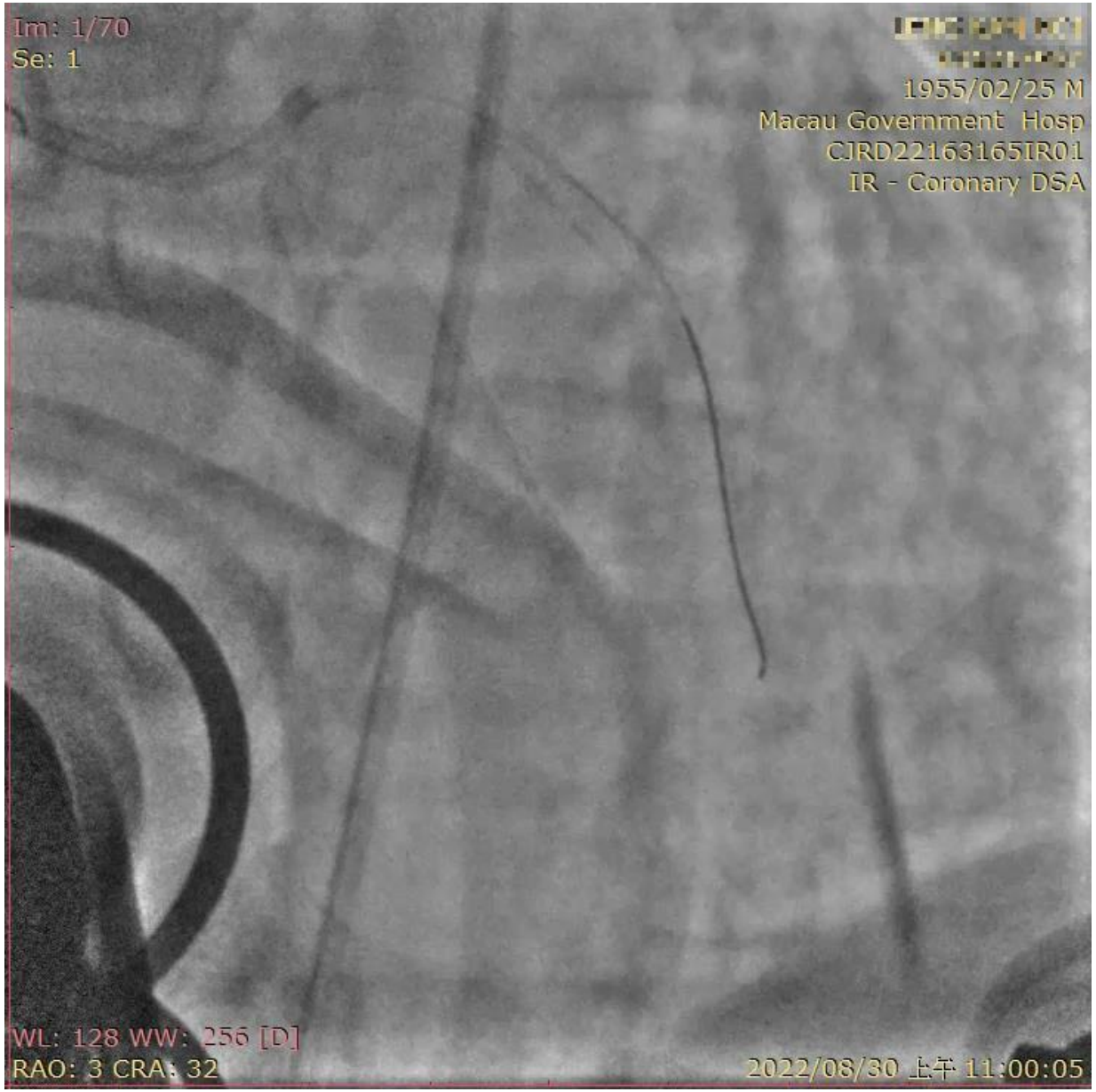
... check plausibility

- Sodium bicarbonate total 200ml IV used.

Coronary angiography was performed under IABP and LUCAS support

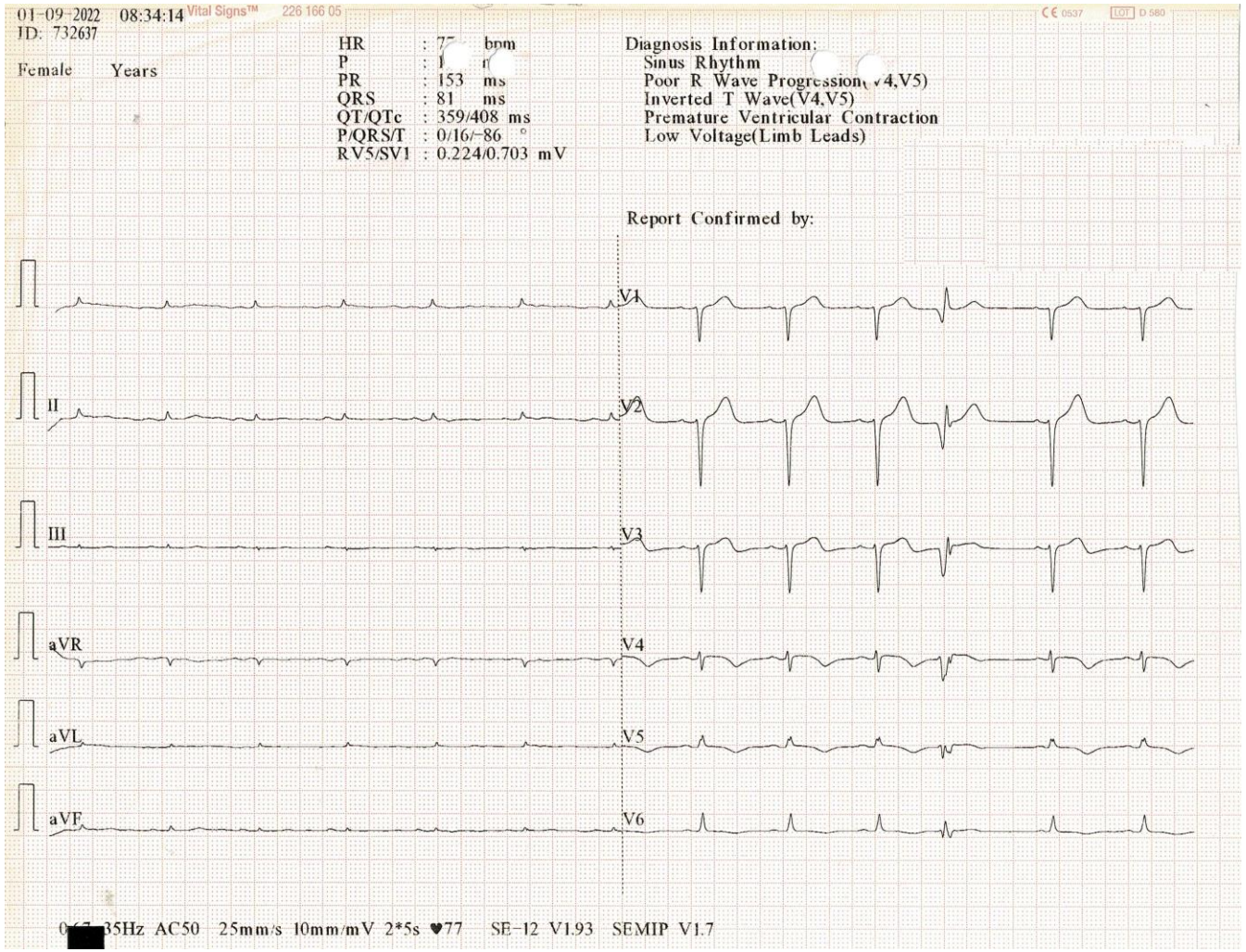



Im: 1/51
Se: 1
1955/02/25 M
Macau Government Hosp
CJRD22163165IR01
IR - Coronary DSA
WL: 128 WW: 256 [D]
RAO: 3 CRA: 32
2022/08/30 上午 10:55:59


Im: 1/70
Se: 1
1955/02/25 M
Macau Government Hosp
CJRD22163165IR01
IR - Coronary DSA
WL: 128 WW: 256 [D]
RAO: 3 CRA: 32
2022/08/30 上午 11:00:05

- Patient remained in shock and hypotensive status after PCI regardless of high dose dopamine and noradrenaline
- V-A ECMO was subsequently inserted in Cath Lab
- Patient was transferred to ICU for management

date	30/8 1st	30/8 2nd	30/8 3rd	31/8	1/9	2/9	3/9	4/9
CK	35	12701	12726	8833	1982	606	258	164
CK-MB		1328	1450	1030	211	57	32	
hsTnT	43.82	28571	50933	36886	10718	1471	1245	-

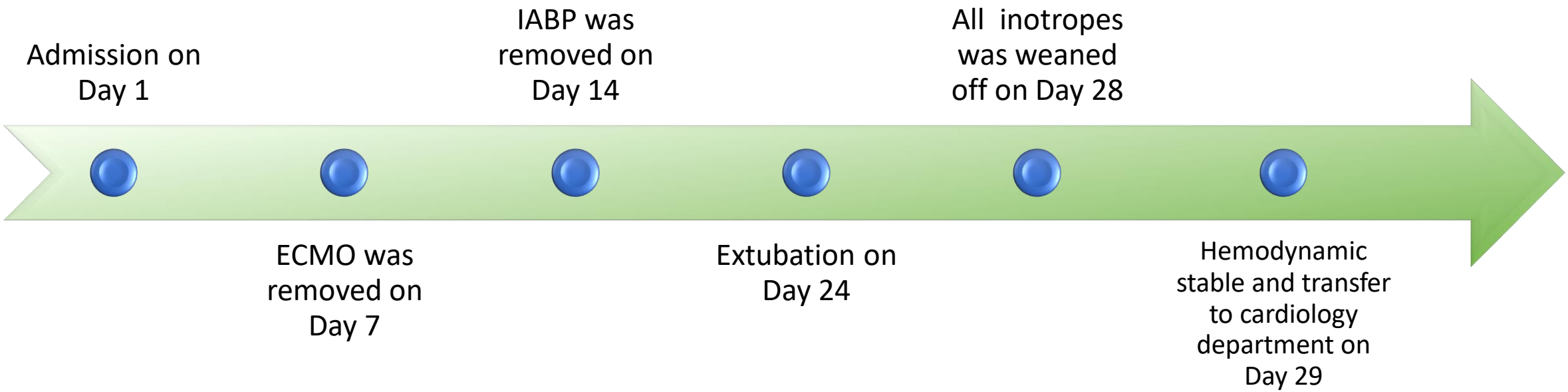


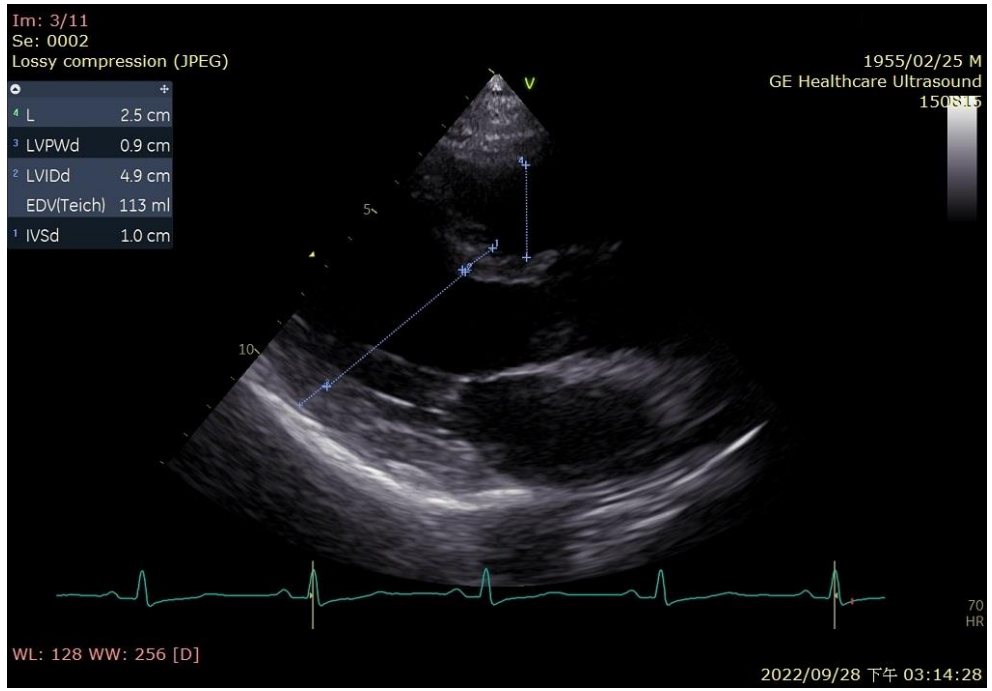
ECG in 2022/09/01

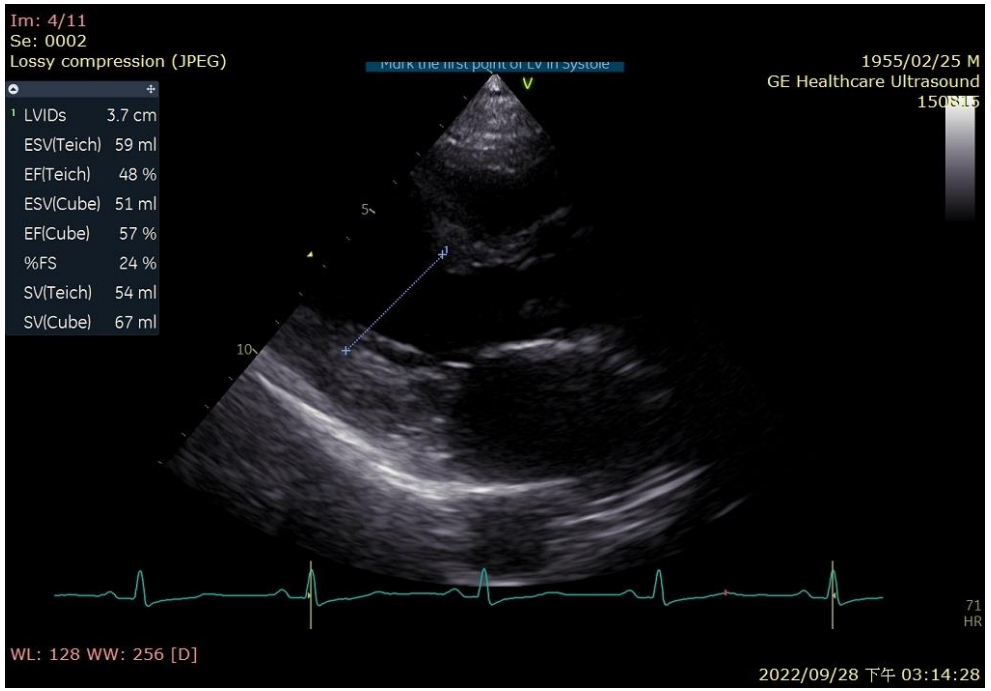
Echo:
EF about 20-25%
Global HK, AK over anteroseptal and apical regional wall

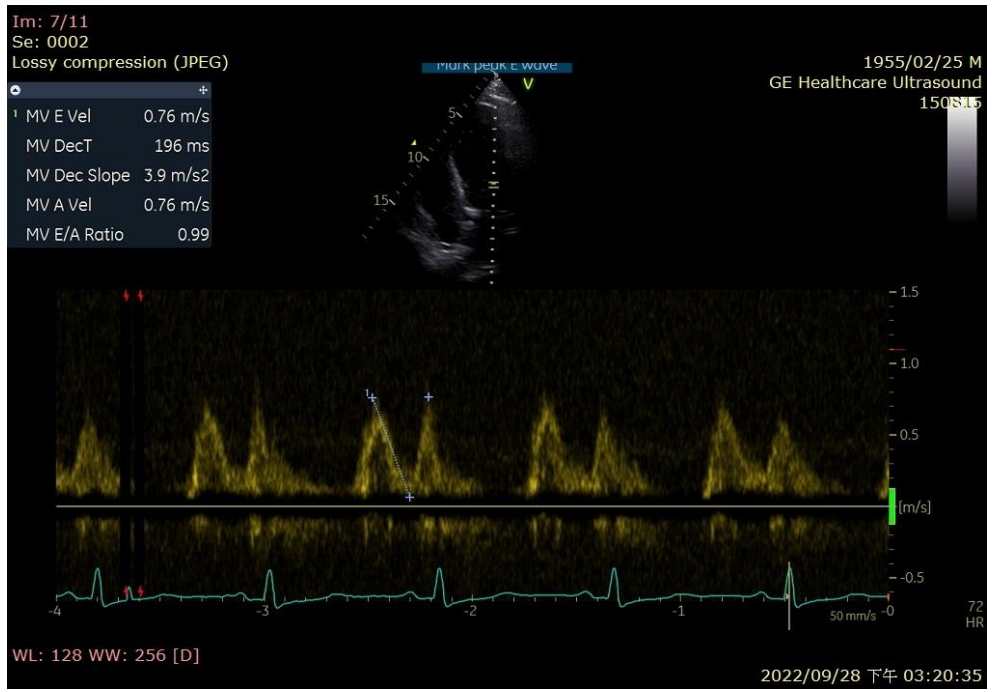
During in ICU (30/8-28/9)

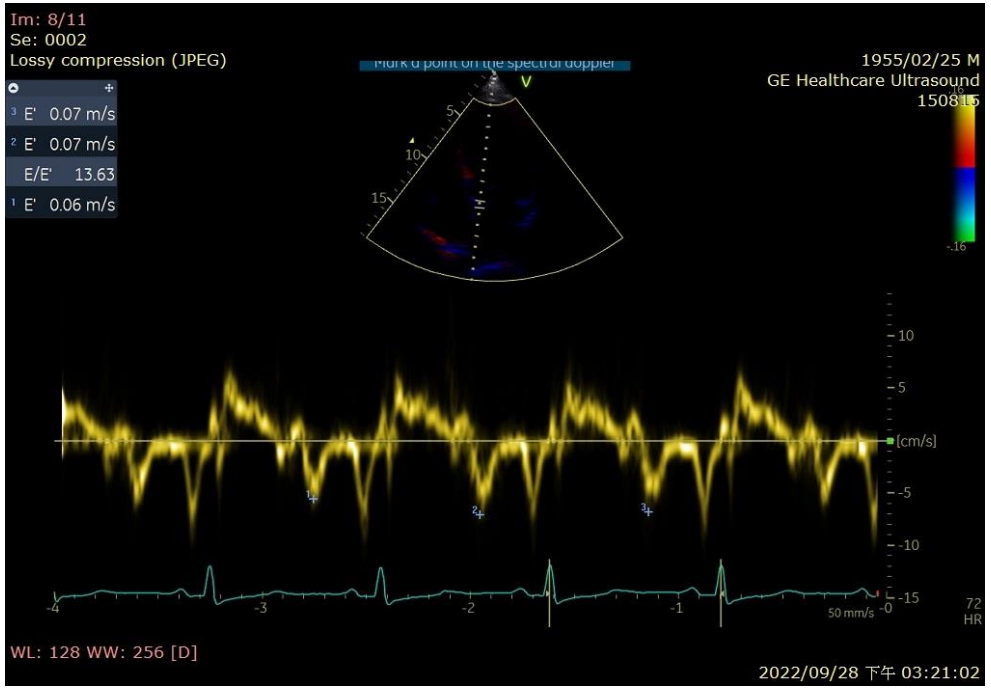
- Patient was continued the VA-ECMO+IABP
- Hypotension persisted, needed noradrenaline and dopamine infusion during VA-ECMO therapy



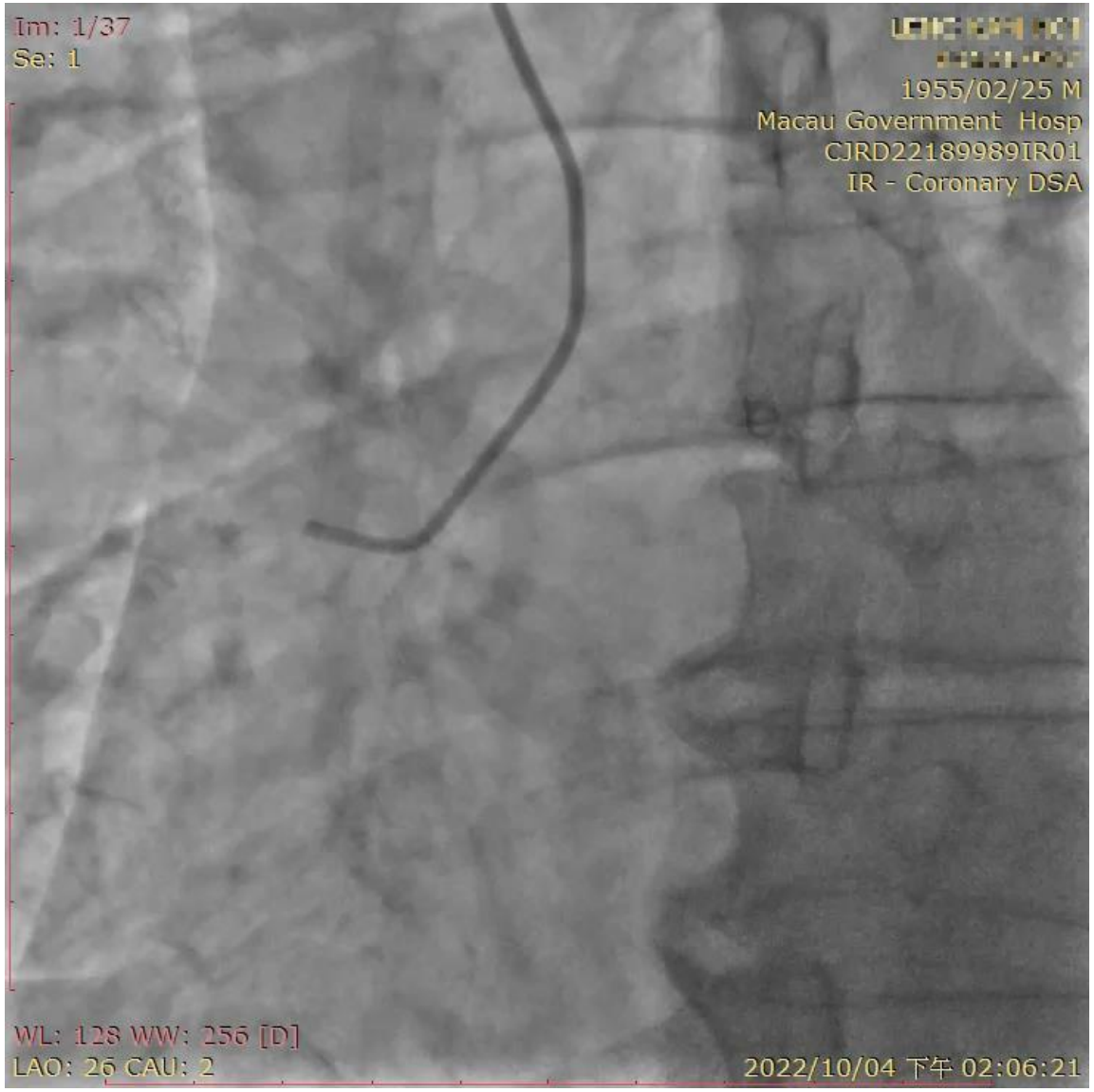

Im: 3/11
Se: 0002
Lossy compression (JPEG)
1955/02/25 M
GE Healthcare Ultrasound
L 2.5 cm
LVPWd 0.9 cm
LVIDd 4.9 cm
EDV(Teich) 113 ml
IVSd 1.0 cm
70 HR
WL: 128 WW: 256 [D]
2022/09/28 下午 03:14:28


Im: 4/11
Se: 0002
Lossy compression (JPEG)
1955/02/25 M
GE Healthcare Ultrasound
LVIDs 3.7 cm
ESV(Teich) 59 ml
EF(Teich) 48 %
ESV(Cube) 51 ml
EF(Cube) 57 %
%FS 24 %
SV(Teich) 54 ml
SV(Cube) 67 ml
71 HR
WL: 128 WW: 256 [D]
2022/09/28 下午 03:14:28


Im: 7/11
Se: 0002
Lossy compression (JPEG)
1955/02/25 M
GE Healthcare Ultrasound
MV E Vel 0.76 m/s
MV DecT 196 ms
MV Dec Slope 3.9 m/s2
MV A Vel 0.76 m/s
MV E/A Ratio 0.99
[m/s]
50 mm/s
72 HR
WL: 128 WW: 256 [D]
2022/09/28 下午 03:20:35


Im: 8/11
Se: 0002
Lossy compression (JPEG)
1955/02/25 M
GE Healthcare Ultrasound
E' 0.07 m/s
E' 0.07 m/s
E/E' 13.63
E' 0.06 m/s
[cm/s]
50 mm/s
72 HR
WL: 128 WW: 256 [D]
2022/09/28 下午 03:21:02

Angiography on 2022/10/04 (Day 35)




Im: 1/53
Se: 1
1955/02/25 M
Macau Government Hosp
CJRD22189989IR01
IR - Coronary DSA
WL: 128 WW: 256 [D]
LAO: 1 CRA: 27
2022/10/04 下午 02:22:58


Im: 1/57
Se: 1
1955/02/25 M
Macau Government Hosp
CJRD22189989IR01
IR - Coronary DSA
WL: 128 WW: 256 [D]
LAO: 33 CAU: 30
2022/10/04 下午 02:57:18

On 2022/10/11 (Day 42)

- Discharge with DAPT, Statin and standard anti-heart failure treatment, including ARNI, SGLT2, MRA and beta-blocker
- Holter assessment ventricular arrhythmia before OPD

.

Holter in 2022/11/10

Location: EDU-Cardiology

HOLTER REPORT

Unit 1023/22

Patient Name
ID
Age 67 yr
Gender Male
Date of Birth:

Hookup Date: 10-Nov-2022
Hookup Time: 15:00:00
Duration: 20:21:00

Overreading Physician
Referring Physician
Ordering Physician:
Hook-Up Technician:
Indication/Diagnosis:
Medications

General

111064	QRS complexes
0	Paced beats (< 1%)
5826	Ventricular beats (5%)
49	Supraventricular beats (< 1%)
0	BB beats (< 1%)
0	Junctional beats (< 1%)
0	Aberrant beats
0	% of total time in AF/AFL
< 1	% of total time classified as noise

Ventriculars (V, F, E, I)

5695	Isolated
64	Couplets
0	Bigeminal cycles
1	Runs totaling 3 beats
3	Beats longest run 129 bpm 01:04:48 11-Nov
3	Beats fastest run 129 bpm 01:04:48 11-Nov

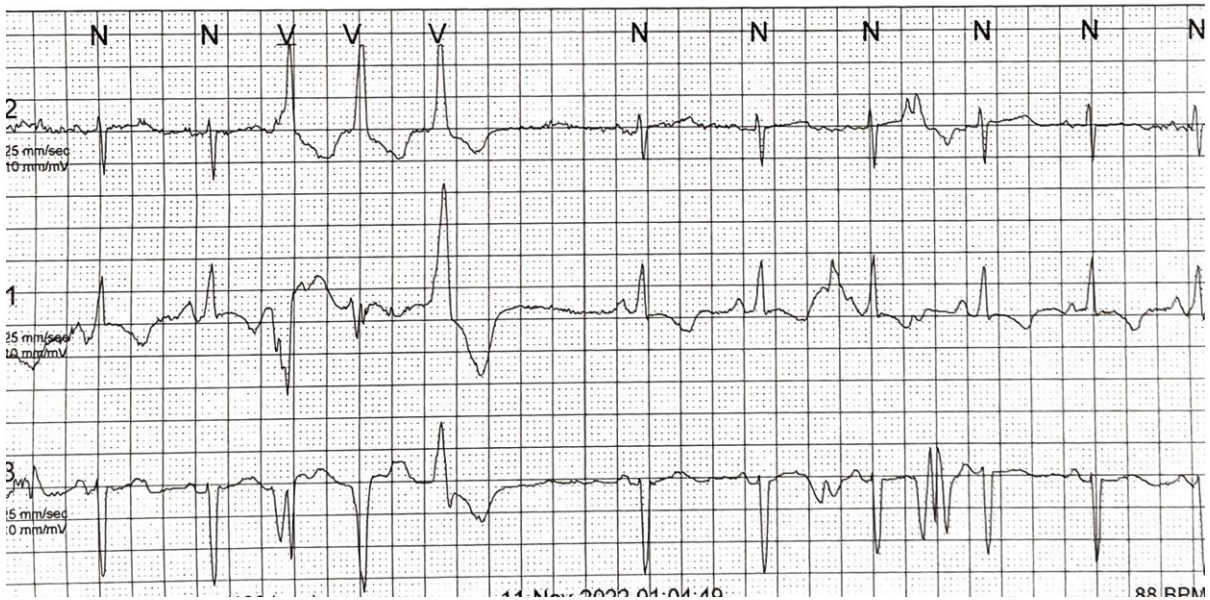
Heart Rates

70	Minimum at 15:17:06 10-Nov
91	Average
129	Maximum at 18:19:57 10-Nov
12318	Beats in tachycardia (>100 bpm), 11% total
0	Beats in bradycardia (<60 bpm), 0% total
1.27	Seconds Max R-R at 01:04:49 11-Nov

Supraventriculars (S, J, A)

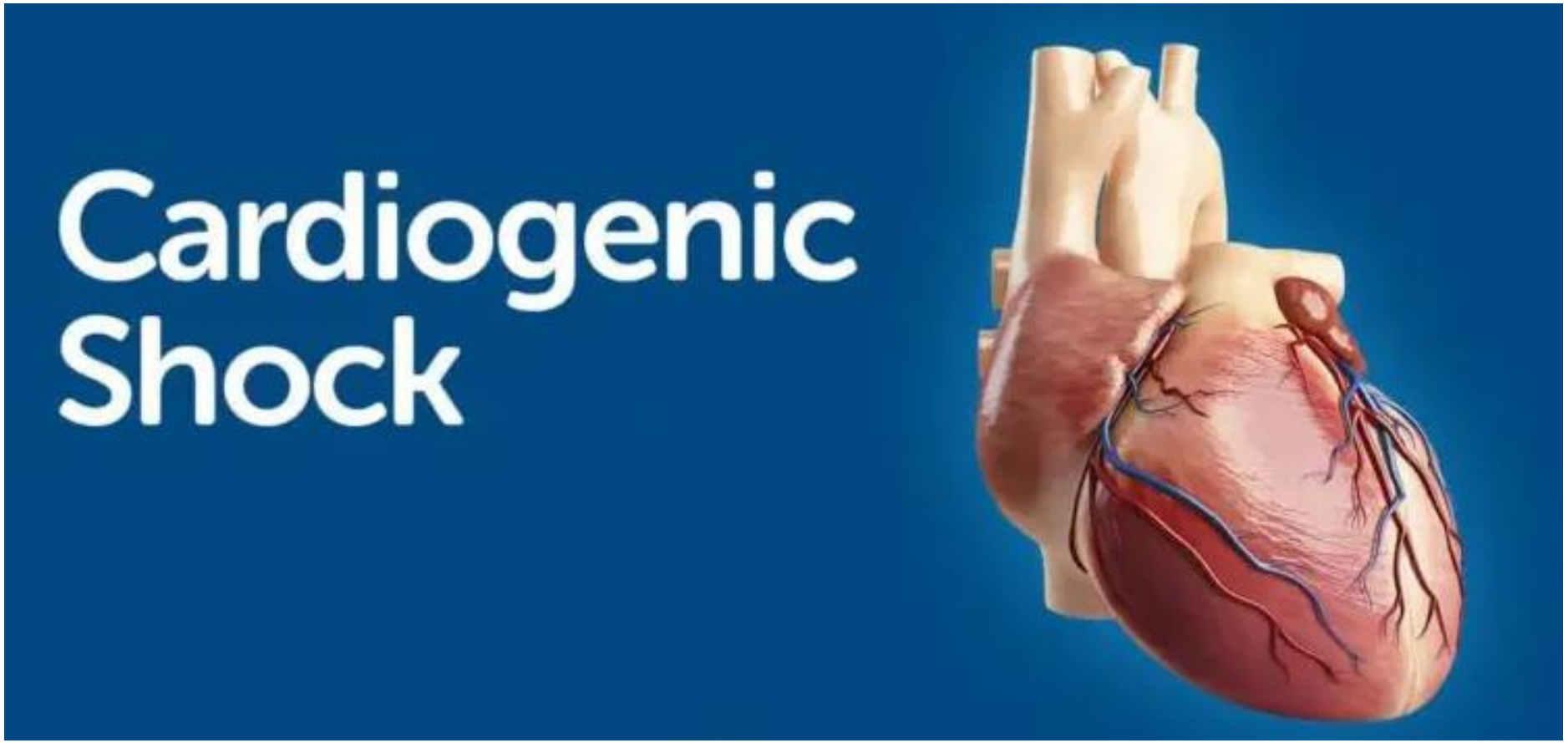
41	Isolated
0	Couplets
0	Bigeminal cycles
1	Runs totaling 8 beats
8	Beats longest run 128 bpm 18:19:56 10-Nov
8	Beats fastest run 128 bpm 18:19:56 10-Nov

ST Channel 1	ST Channel 2	ST Channel 3
1.2 mm at 16:11:15 10-Nov	2.6 mm at 10:17:30 11-Nov	4.6 mm at 09:59:15 11-Nov
-1.6 mm at 21:04:45 10-Nov	-0.2 mm at 18:09:45 10-Nov	-0.2 mm at 19:21:00 10-Nov



- Put the patient on the waiting list for ICD implantation
- Due to COVID-19 pandemic in 12/2022-01/2023, admission was delayed
- Called the patient. It is known that the patient died just 5 days before the end of January 2023

Cardiogenic shock complicating myocardial infarction

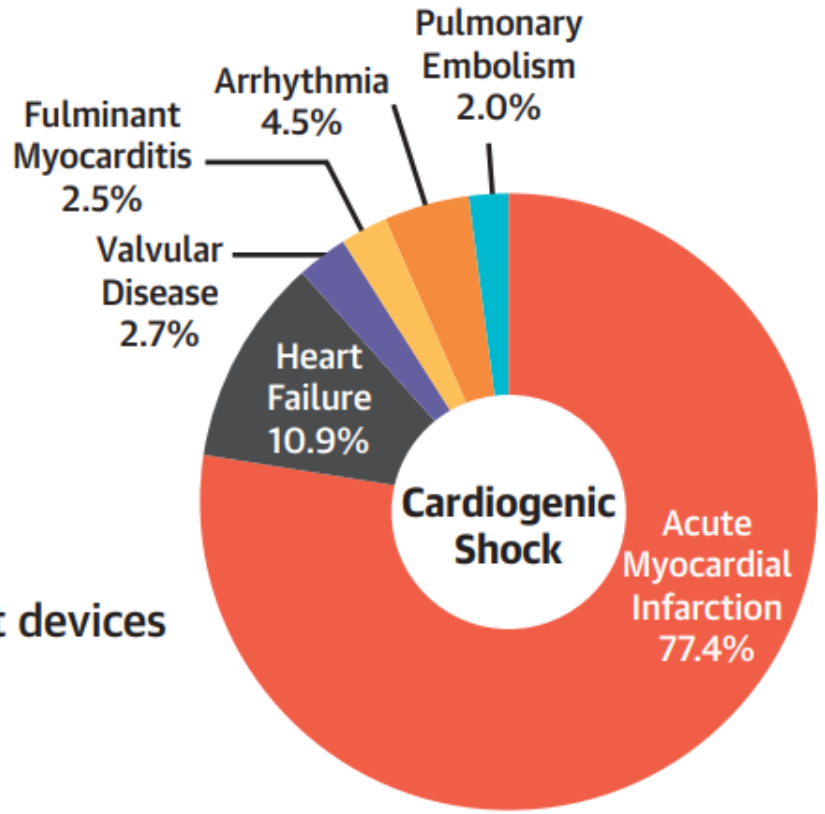


CENTRAL ILLUSTRATION **Cause of Cardiogenic Shock, Mechanical Circulatory Support Patterns, and In-Hospital Mortality in Cardiogenic Shock**

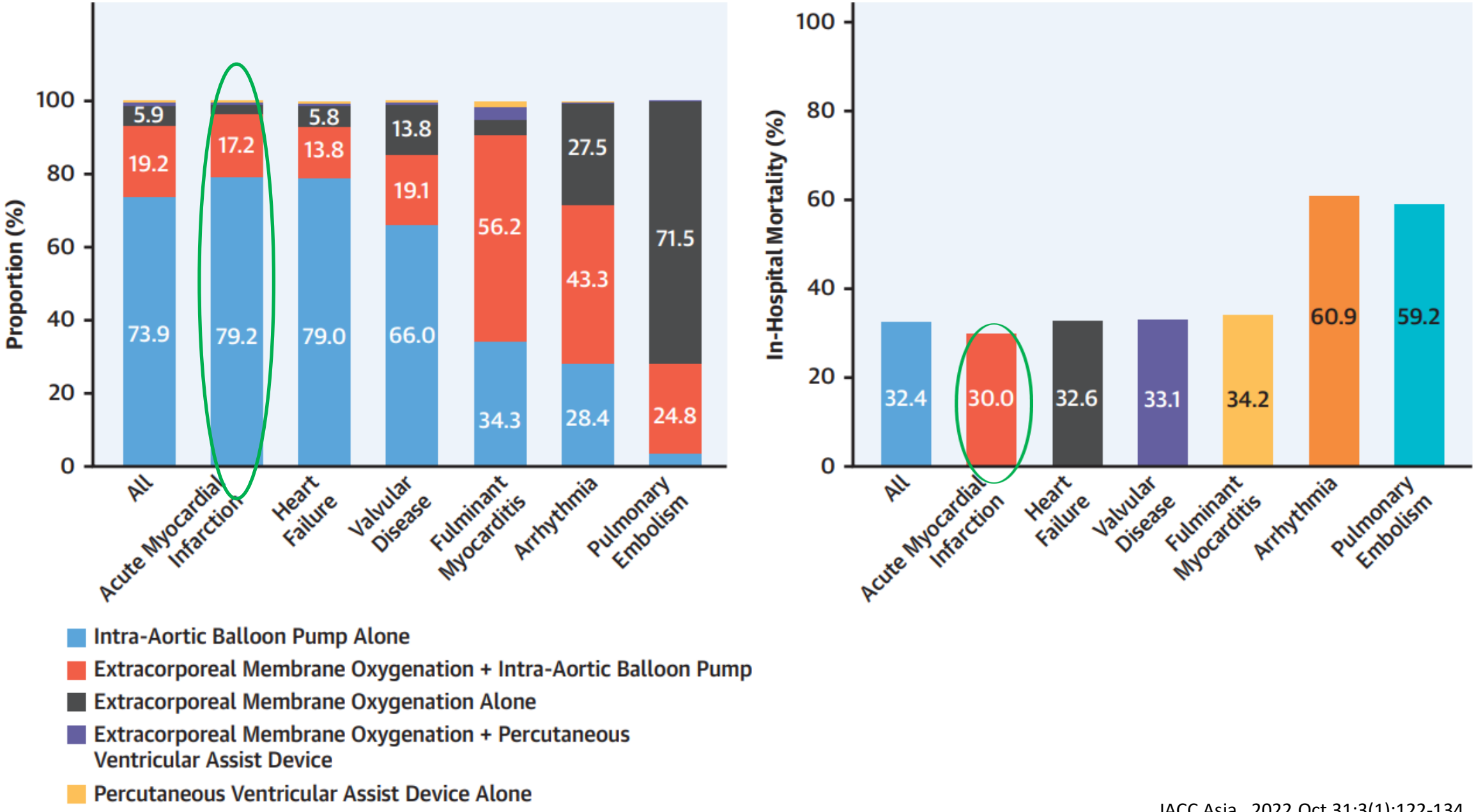
From Japanese Registry of All Cardiac and Vascular Diseases-Diagnosis Procedure Combination

927 hospitals
Apr.2012 - Mar.2020

65,837 cardiogenic shock patients
who received mechanical circulatory support devices



JACC Asia . 2022 Oct 31;3(1):122-134



JACC Asia . 2022 Oct 31;3(1):122-134

Risk factors associated with development of cardiogenic shock

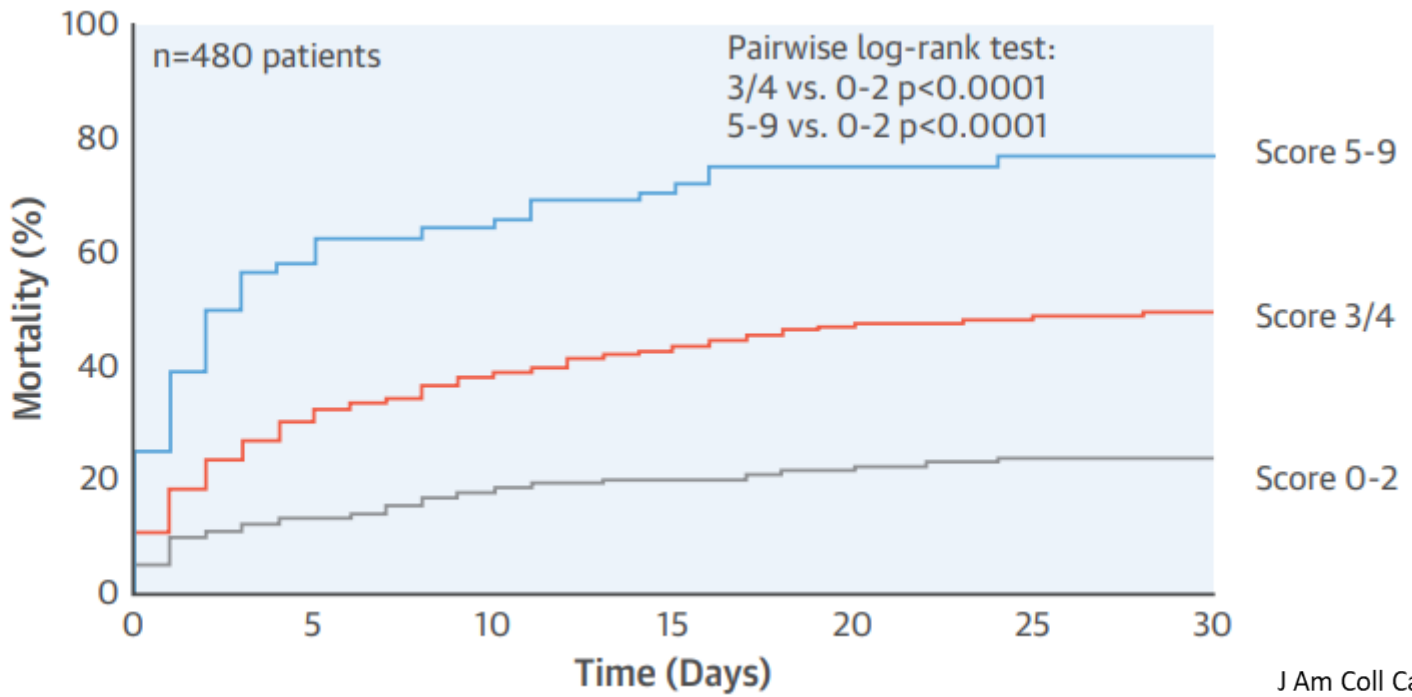
- Older age
- Female sex
- Prior myocardial infarction (MI) or diagnosis of heart failure on admission
- History of hypertension and/or diabetes mellitus
- Systolic blood pressure <120 mmHg, heart rate >90/min
- Anterior MI
- Completed infarct
- Multi-vessel coronary artery disease
- Complete heart block
- left bundle branch block

Circulation. 2008;117(5):686.
Clin Cardiol. 2019 Apr;42(4):484-493
J Am Coll Cardiol. 2000;35(1):136.

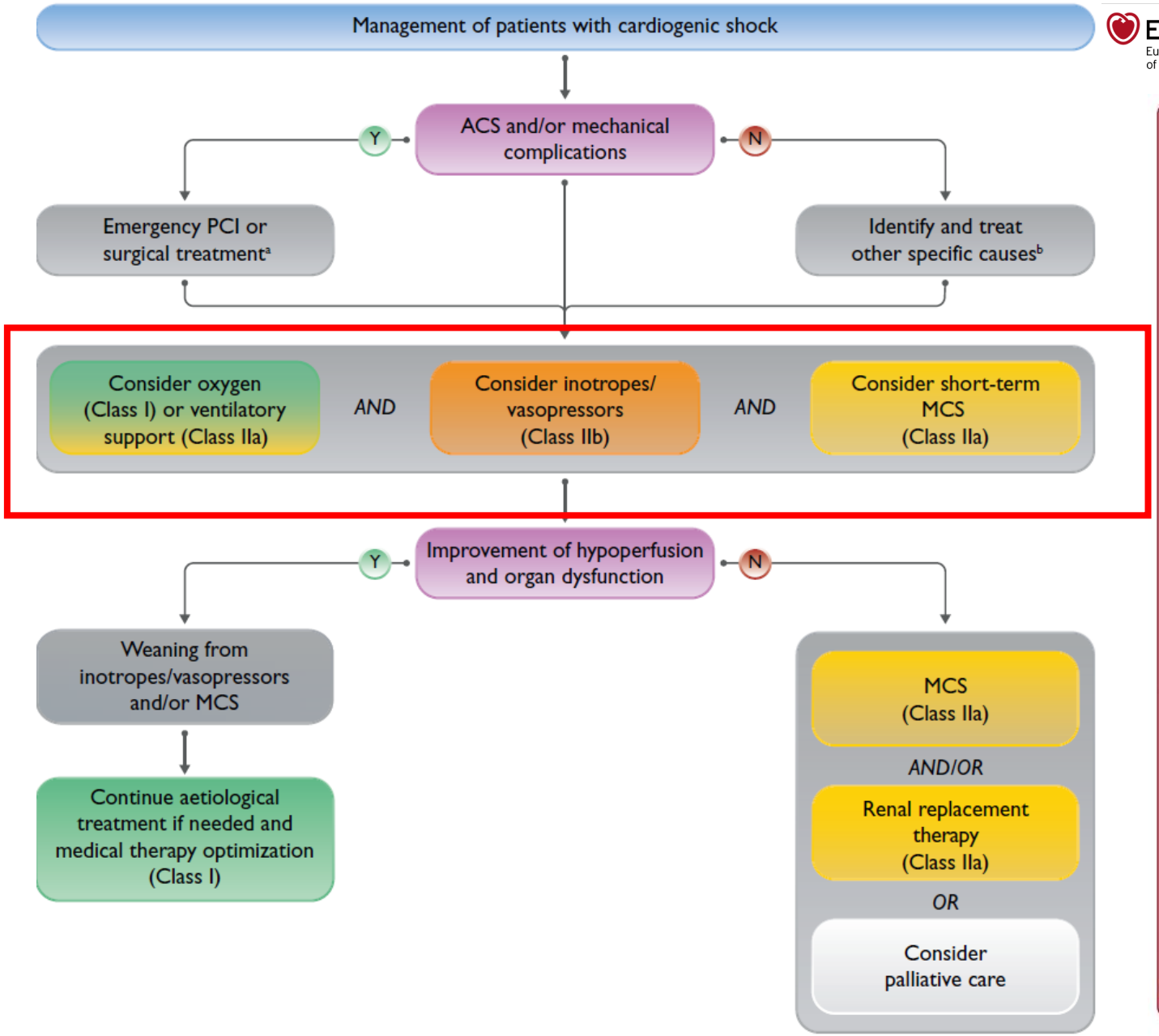
CENTRAL ILLUSTRATION **Cardiogenic Shock Complicating Acute Myocardial Infarction: IABP-SHOCK II Risk Score**

Score	
Variable	Points
Age >73 years	1
History of stroke	2
Glucose >10.6 mmol/l (191 mg/dl)*	1
Creatinine >132.6 μmol/l (1.5 mg/dl)*	1
Arterial lactate >5 mmol/l*	2
TIMI flow grade <3 after PCI	2
Maximum	9

Risk categories	
Category	Points
Low	0-2
Intermediate	3/4
High	5-9

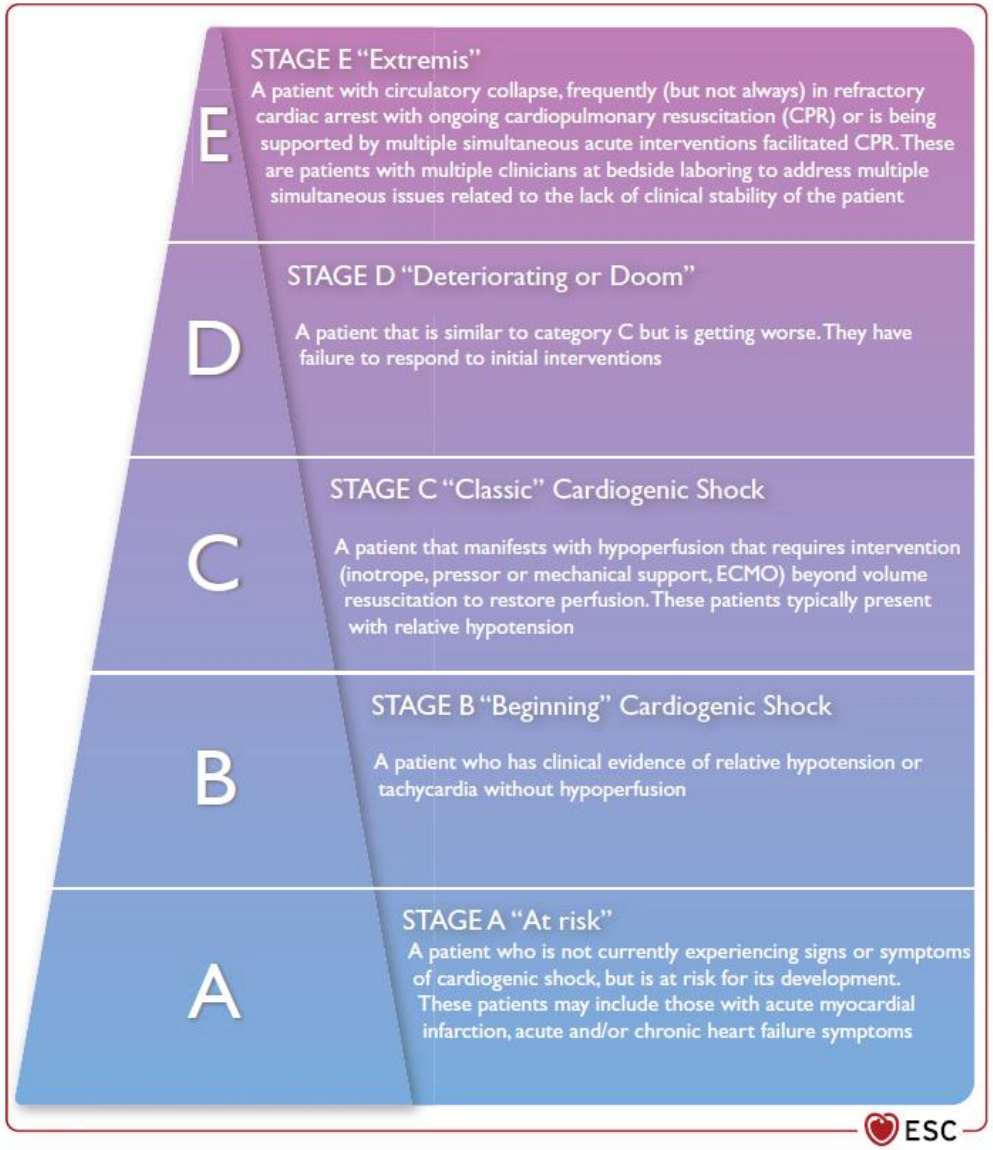


J Am Coll Cardiol . 2017 Apr 18;69(15):1913-1920



ESC European Society of Cardiology

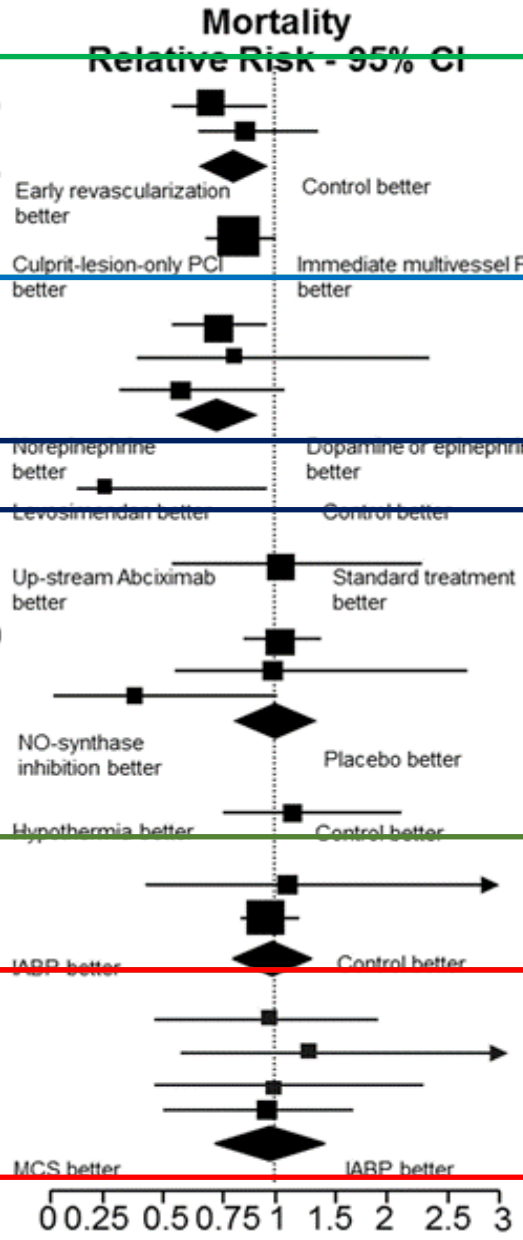
Stages of cardiogenic shock.



European Heart Journal (2021) 42,3599-3726
European Heart Journal (2021) 00, 1-42

Current evidence from randomized clinical trials in cardiogenic shock in the percutaneous coronary intervention era

Trial	Follow-up	n/N	n/N	Relative Risk - 95% CI
Revascularization (PCI/CABG)				
SHOCK	1 year	81/152	100/150	0.72 (0.54;0.95)
SMASH	30 days	22/32	18/23	0.87 (0.66;1.29)
Total		**103/184**	**118/173**	**0.82 (0.69;0.97)**
Type of revascularization				
CULPRIT-SHOCK	30 days	149/344	176/341	0.84 (0.72;0.98)
Vasopressors				
SOAP-2 (CS subgroup)	28 days	50/145	64/135	0.73 (0.54;0.97)
Levy et al.	28 days	4/15	5/15	0.80 (0.27;2.30)
OptimaCC	28 days	8/30	13/27	0.55 (0.27;1.10)
Total		**62/190**	**82/177**	**0.70 (0.54;0.91)**
Inotropes				
Fuhrmann et al.	30 days	5/16	10/16	0.33 (0.11;0.97)
Glycoprotein IIb/IIIa-Inhibitors				
PRAGUE-7	In-hospital	15/40	13/40	1.15 (0.59;2.27)
NO-Synthase-Inhibition				
TRIUMPH	30 days	97/201	76/180	1.14 (0.91;1.45)
SHOCK II	30 days	24/59	7/20	1.16 (0.59;2.69)
Cotter et al.	30 days	4/15	10/15	0.40 (0.13;1.05)
Total		**125/275**	**93/215**	**1.05 (0.85;1.29)**
Hypothermia				
SHOCK-COOL	30 days	12/20	10/20	1.20 (0.68;2.17)
IABP				
IABP-SHOCK I	30 days	7/19	6/21	1.28 (0.45;3.72)
IABP-SHOCK II	30 days	19/301	123/298	0.96 (0.79-1.17)
Total		**126/319**	**129/319**	**0.98 (0.81;1.18)**
Mechanical circulatory support				
Thiele et al.	30 days	9/21	9/20	0.95 (0.48;1.90)
Burkhoff et al.	30 days	9/19	5/14	1.33 (0.57-3.10)
ISAR-SHOCK	30 days	6/13	6/13	1.00 (0.44-2.29)
IMPRESS-IN-SEVERE-SHOCK	30 days	11/24	12/24	0.92 (0.50-1.66)
Total		**35/77**	**32/71**	**1.01 (0.71;1.44)**

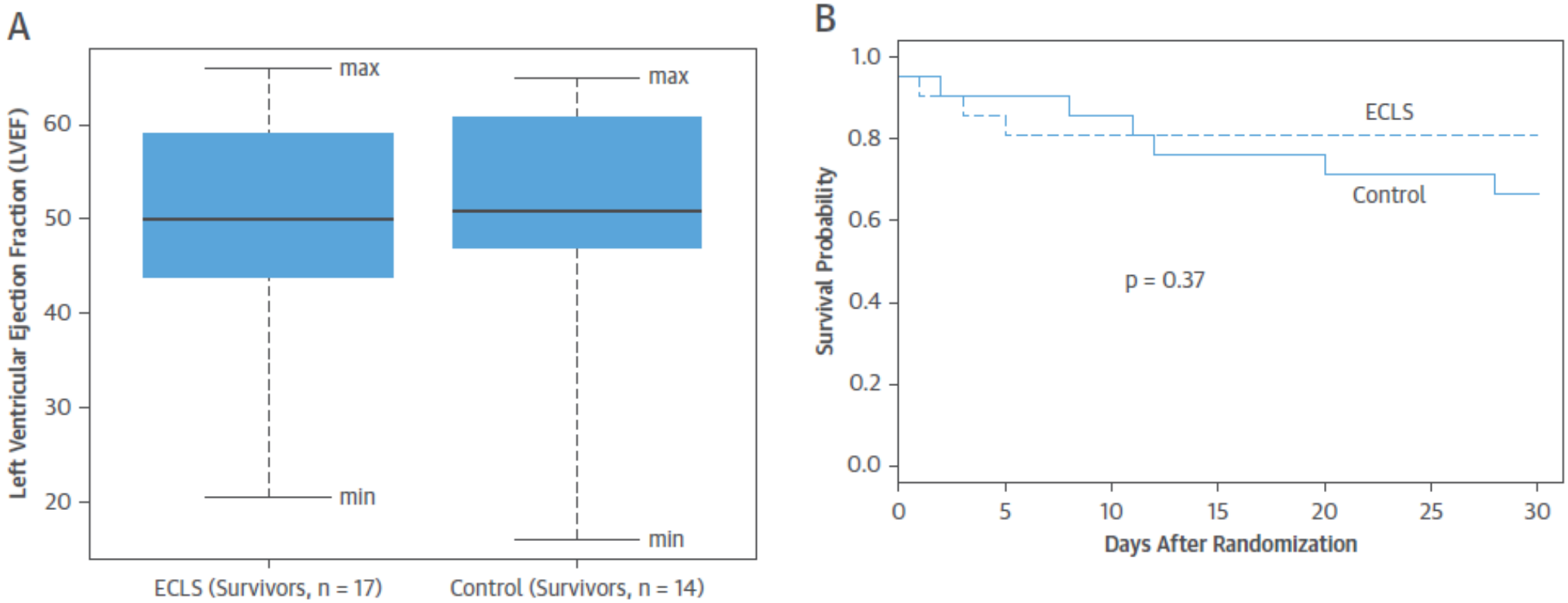


Eur Heart J. 2019 Aug 21;40(32):2671-2683

Extracorporeal Life Support in Cardiogenic Shock Complicating Acute Myocardial Infarction

Stefan Brunner, Sabina P W Guenther, Korbinian Lackermair, Sven Peterss, Martin Orban, Anne-Laure Boulesteix, Sebastian Michel, Jörg Hausleiter, Steffen Massberg, Christian Hagl

FIGURE 1 LVEF and Survival Curves at 30 Days



(A) Left ventricular ejection fraction (LVEF) at 30 days: primary endpoint. **(B)** Survival estimates through 30 days after randomization. ECLS = extracorporeal life support.

J Am Coll Cardiol . 2019 May 14;73(18):2355-2357

Clinical Research in Cardiology
https://doi.org/10.1007/s00392-020-01778-8

ORIGINAL PAPER

Outcome of patients treated with extracorporeal life support in cardiogenic shock complicating acute myocardial infarction: 1-year result from the ECLS-Shock study

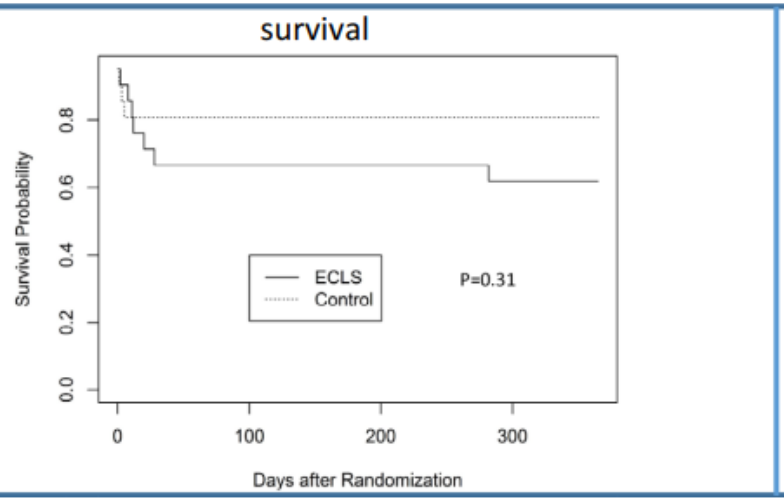
1 year results from the ECLS Shock trial

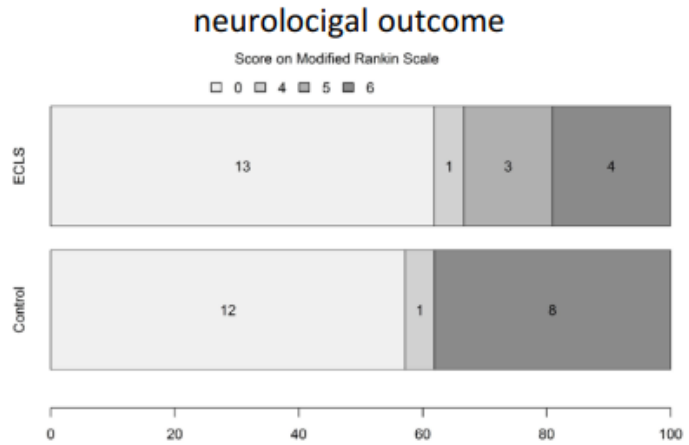
patients with AMI-CS undergoing early revascularization

randomization

best medical therapy (control)

best medical therapy + ECLS (ECLS)





Clin Res Cardiol . 2021 Sep;110(9):1412-1420

Circulation

ORIGINAL RESEARCH ARTICLE

Extracorporeal Membrane Oxygenation in the Therapy of Cardiogenic Shock: Results of the ECMO-CS Randomized Clinical Trial

Petr Ostadal, MD, PhD; Richard Rokyta, MD, PhD; Jiri Karasek, MD, PhD; Andreas Kruger, MD, PhD; Dagmar Vondrakova, MD, PhD; Marek Janotka, MD; Jan Naar, MD, PhD; Jana Smalcova, MD; Marketa Hubatova, MSc; Milan Hromadka, MD, PhD; Stefan Volovar, MD; Miroslava Seyfrydova, MD; Jiri Jarkovsky, PhD; Michal Svoboda, MSc; Ales Linhart, MD, PhD; Jan Belohlavek, MD, PhD; for the ECMO-CS Investigators

Table 3. Incidence of the Composite Primary End Point, Individual Components of the Composite Primary End Point and Secondary Composite Outcomes

End point, n (%)	VA-ECMO N=58	Conservative N=59	Risk difference (95% CI)	Hazard ratio (95% CI)
Composite primary outcome—composite of death from any cause, implantation of another mechanical circulatory support, resuscitated cardiac arrest	37 (63.8)	42 (71.2)	−7.4 (−24.3 to 9.5)	0.721 (0.463 to 1.123)
Death	29 (50.0)	28 (47.5)	2.5 (−15.6 to 20.7)	1.110 (0.660 to 1.866)
Another mechanical circulatory support	10 (17.2)	25 (42.4)	−25.1 (−41.1 to −9.2)	0.380 (0.182 to 0.793)
Resuscitated cardiac arrest	6 (10.3)	8 (13.6)	−3.2 (−15.0 to 8.5)	0.790 (0.274 to 2.277)
Composite of death from any cause or resuscitated cardiac arrest	31 (53.4)	32 (54.2)	−0.8 (−18.9 to 17.3)	1.037 (0.633 to 1.700)
Composite of death from any cause, implantation of another mechanical circulatory support, resuscitated cardiac arrest, and serious adverse event	51 (87.9)	50 (84.7)	3.2 (−9.2 to 15.6)	

VA-ECMO indicates veno-arterial extracorporeal membrane oxygenation.

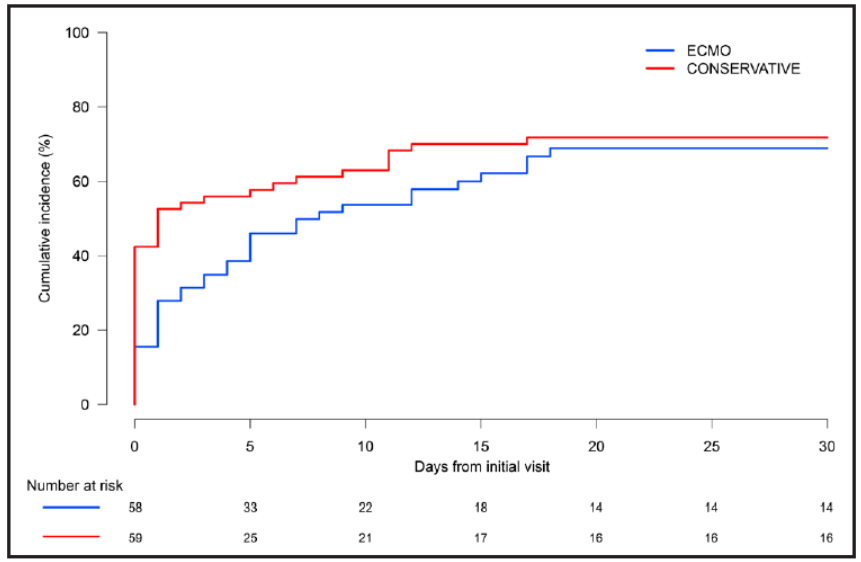


Figure 1. Cumulative incidence of the composite primary end point.
ECMO indicates extracorporeal membrane oxygenation.

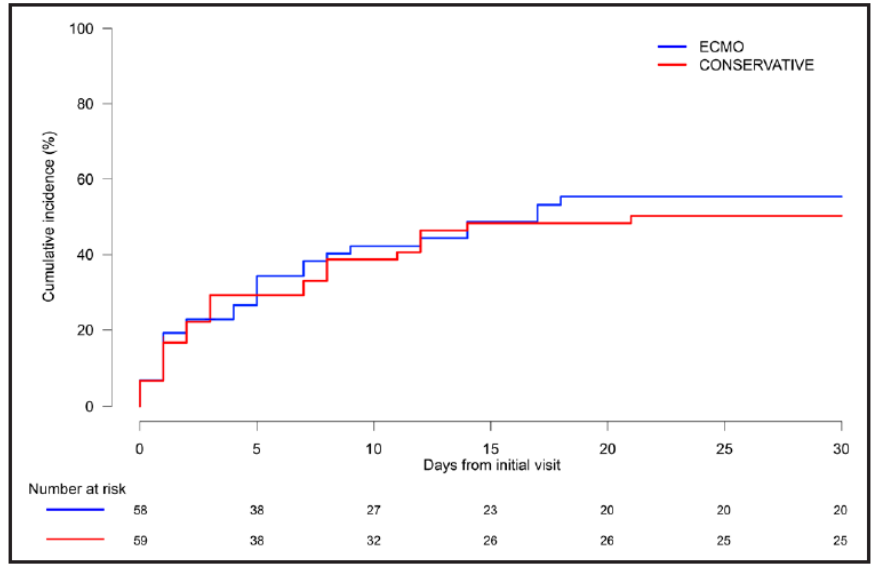


Figure 2. Cumulative incidence of all-cause death.
ECMO indicates extracorporeal membrane oxygenation.

Circulation. 2023;147:454–464.

Ongoing randomized trials of VA-ECMO in AMI-CS

Name	NCT No.	Status	Projected N
Populations with AMI-CS			
ECLS-SHOCK	NCT03637205	Recruiting	420
EURO-SHOCK	NCT03813134	Recruiting	428
ANCHOR	NCT04184635	Recruiting	400

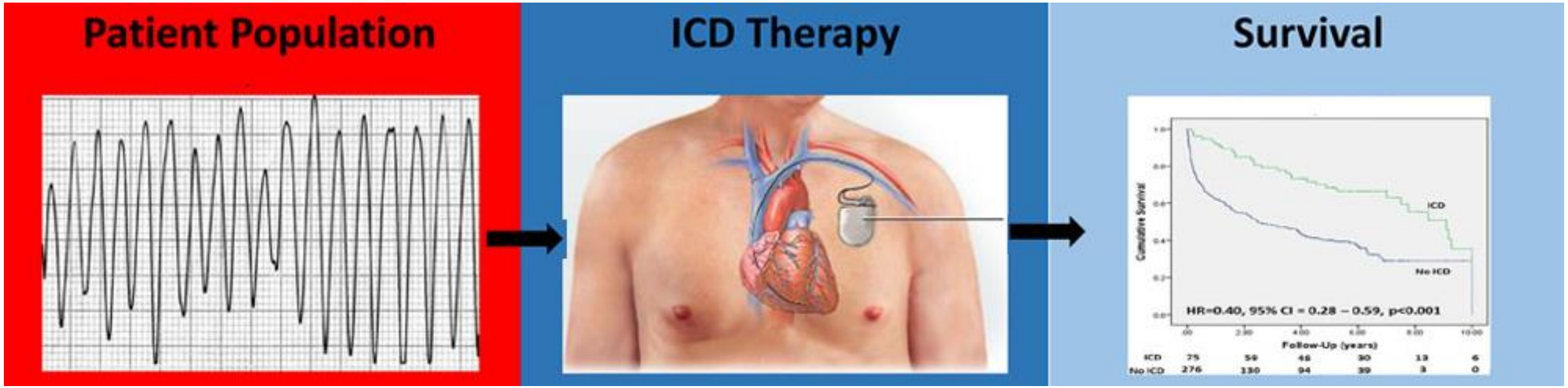
From clinicaltrials.gov search on June 05, 2023

Table 1. Ongoing Randomized Trials of VA-ECMO in AMI-CS.

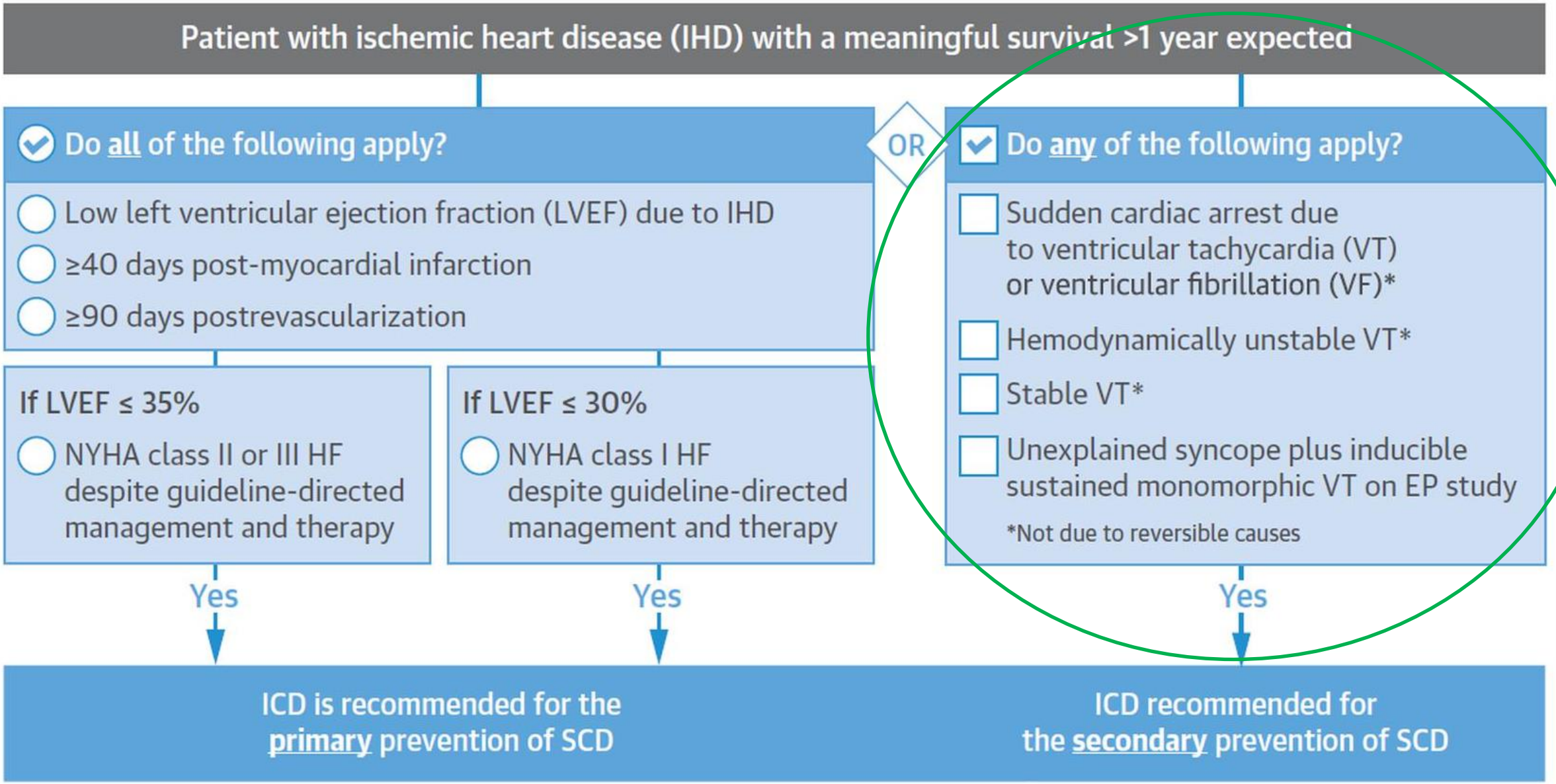
	ECLS-SHOCK	EURO-SHOCK	ANCHOR
Identifier	NCT03637205	NCT03813134	NCT04184635
Sample Size	420 patients	428 patients	400 patients
First Patient in	June 2019	January 2020	October 2021
Patient enrolment as of January 2022	300	33	<10
Main Inclusion Criteria	• Infarct-related CS (STEMI or NSTEMI) < 12 h • Arterial lactate > 3 mmol/L • Planned revascularization • Age: 18–80 years • In case of prior CPR: duration < 45 min	• Infarct-related CS (STEMI or NSTEMI) • Presentation ≤ 24 h after ACS symptom onset • Persistence of CGS 30 min after revascularization attempt of culprit coronary artery • Arterial lactate > 2 mmol/L • Age: 18–90 years	• Infarct-related CS (STEMI or NSTEMI) < 24 h) • PCI performed or planned in the following 60 min • Age >18 years • In case of prior CPR: duration < 30 min
Treatment Arms	Optimal medical therapy vs. VA-ECMO plus optimal medical therapy	Optimal medical therapy vs. Early VA-ECMO plus optimal medical therapy	Optimal medical therapy vs. Early VA-ECMO and IABP plus optimal medical therapy
Primary Outcome	All-cause 30-day mortality	All-cause 30-day mortality	Treatment failure at day 30 (death in the ECMO group and death or rescue ECMO in the control group)
Special Characteristics	VA-ECMO arm: VA-ECMO insertion preferably prior PCI Non-VA-ECMO arm: Use of other mechanical circulatory support than VA-ECMO possible in case of defined escalation criteria	VA-ECMO arm: VA-ECMO insertion 30 min until 6 h after PCI Non-VA-ECMO arm: IABP insertion not permitted	VA-ECMO arm: VA-ECMO insertion as soon as possible Non-VA-ECMO arm: Use of IABP not recommended, other mechanical circulatory support devices not permitted

IABP = intra-aortic balloon counterpulsation; (N)STEMI = (non-)ST-segment elevation myocardial infarction; PCI = percutaneous coronary intervention; VA-ECMO = veno-arterial extracorporeal membrane oxygenation.

Challenge of ICD implantation



Indications for Implantable Cardioverter-Defibrillator (ICD) in Patients with Ischemic Heart Disease (IHD) to Prevent Sudden Cardiac Death (SCD)



J Am Coll Cardiol. 2018;72(14):e91.

ESC European Society of Cardiology
European Heart Journal (2022) **43**, 3997–4126
https://doi.org/10.1093/eurheartj/ehac262

2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

Recommendations	Class[a]	Level[b]
Risk stratification		
Early (before discharge) assessment of LVEF is recommended in all patients with acute MI.[567,568]	I	B
In patients with pre-discharge LVEF ≤40%, re-evaluation of LVEF 6–12 weeks after MI is recommended to assess the potential need for primary prevention ICD implantation.[568,573,574]	I	C
Treatment of VAs		
Catheter ablation should be considered in patients with recurrent episodes of PVT/VF triggered by a similar PVC non-responsive to medical treatment or coronary revascularization in the subacute phase of MI.[332]	IIa	C

Recommendations	Class[a]	Level[b]
Risk stratification and primary prevention of SCD		
In patients with syncope and previous STEMI, PES is indicated when syncope remains unexplained after non-invasive evaluation.[146,584]	I	C
ICD therapy is recommended in patients with CAD, symptomatic heart failure (NYHA class II–III), and LVEF ≤35% despite ≥3 months of OMT.[354,356]	I	A
ICD therapy should be considered in patients with CAD, NYHA class I, and LVEF ≤30% despite ≥3 months of OMT.[354]	IIa	B
ICD implantation should be considered in patients with CAD, LVEF ≤40% despite ≥3 months of OMT, and NSVT, if they are inducible for SMVT by PES.[355]	IIa	B
In patients with CAD, prophylactic treatment with AADs other than beta-blockers is not recommended.[556,578,579]	III	A

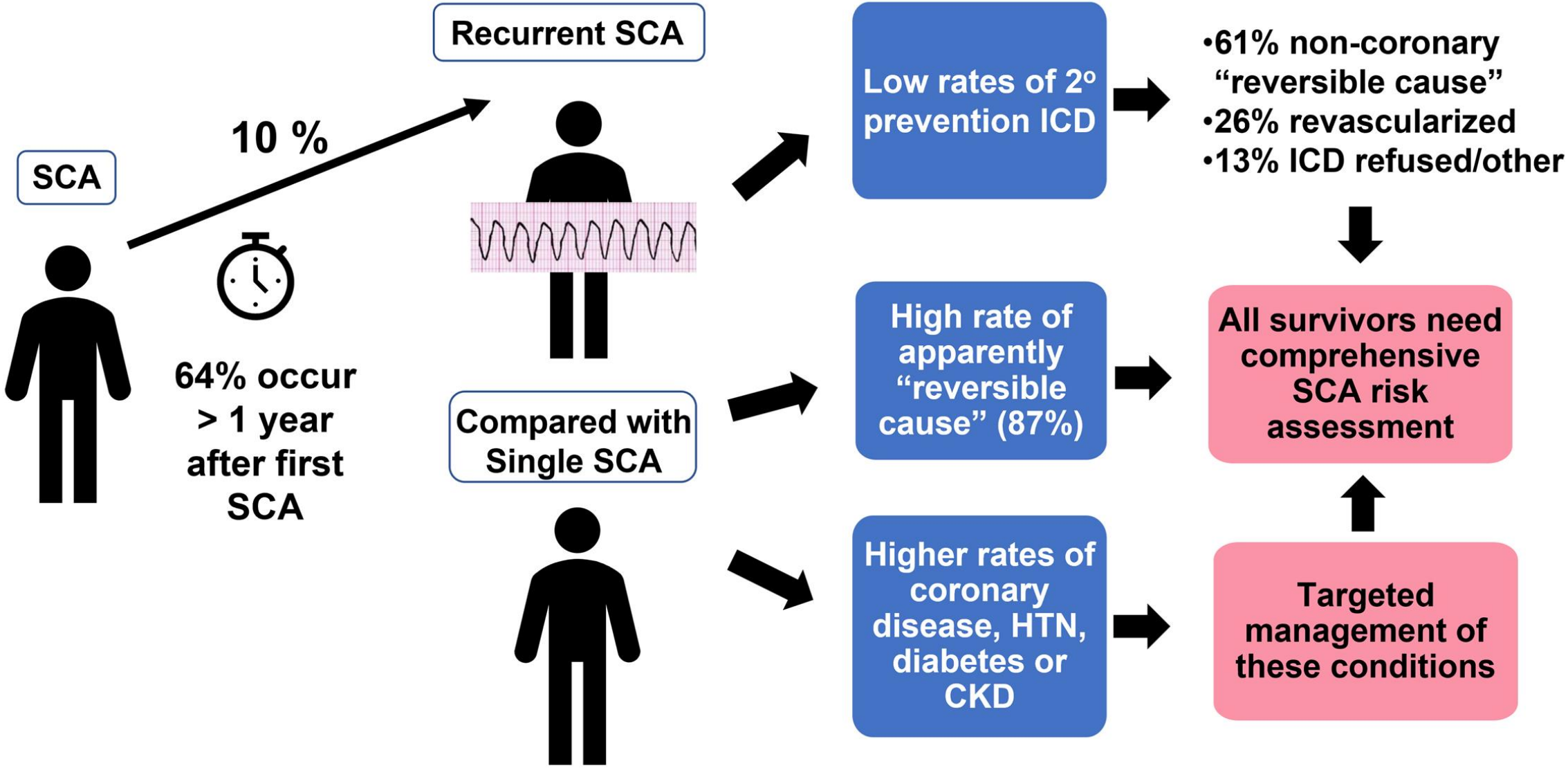
Eur Heart J. 2022 Oct 21;43(40):3997-4126

Recommendations	Class[a]	Level[b]
Secondary prevention of SCD and treatment of VAs		
ICD implantation is recommended in patients without ongoing ischaemia with documented VF or haemodynamically not-tolerated VT occurring later than 48 h after MI.[349–351]	I	A
In patients with CAD and recurrent, symptomatic SMVT, or ICD shocks for SMVT despite chronic amiodarone therapy, catheter ablation is recommended in preference to escalating AAD therapy.[471]	I	B
The addition of oral amiodarone or beta-blocker replacement by sotalol should be considered in patients with CAD with recurrent, symptomatic SMVT, or ICD shocks for SMVT while on beta-blocker treatment.[318,581]	IIa	B

Recommendations	Class[a]	Level[b]
Secondary prevention of SCD and treatment of VAs		
In patients with CAD and haemodynamically well-tolerated SMVT and LVEF ≥40%, catheter ablation in experienced centres should be considered as an alternative to ICD therapy, provided that established endpoints have been reached.[c,480,580]	IIa	C
ICD implantation should be considered in patients with a haemodynamically tolerated SMVT and an LVEF ≥40% if VT ablation fails, is not available, or is not desired.	IIa	C
Catheter ablation should be considered in patients with CAD and recurrent, symptomatic SMVT, or ICD shocks for SMVT despite beta-blockers or sotalol treatment.[471]	IIa	C
In patients with CAD eligible for ICD implantation, catheter ablation may be considered just before (or immediately after) ICD implantation to decrease subsequent VT burden and ICD shocks.[484,485,582,583]	IIb	B

Eur Heart J. 2022 Oct 21;43(40):3997-4126

Recurrent Sudden Cardiac Arrest: Prevalence & Clinical Factors



Circ Arrhythm Electrophysiol . 2022 Dec;15(12):e011018

Take home messages

- Mortality due to CS-AMI is high
- MCS has not improved outcomes in CS-AMI
- Interpretation of randomized trials remains difficult
- Without better studies, the effects of MCS in CS-AMI will remain uncertain
- ICD implantation is generally considered the first-line treatment option for the secondary prevention of SCD and for primary prevention in high risk of SCD due to VT/VF


Thank You