Figure S1 In-hospital outcome in patients with D-CS in the derivation cohort. D-CS, deterioration of cardiogenic shock.
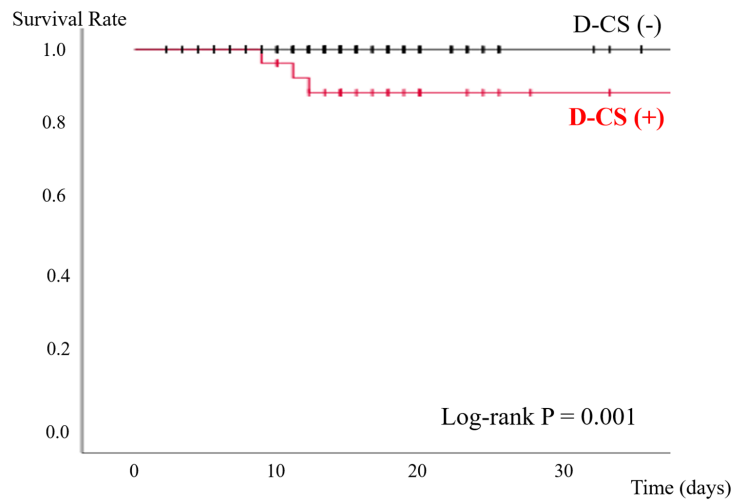

Figure S2 In-hospital outcome in patients with D-CS in the validation cohort. D-CS, deterioration of cardiogenic shock.
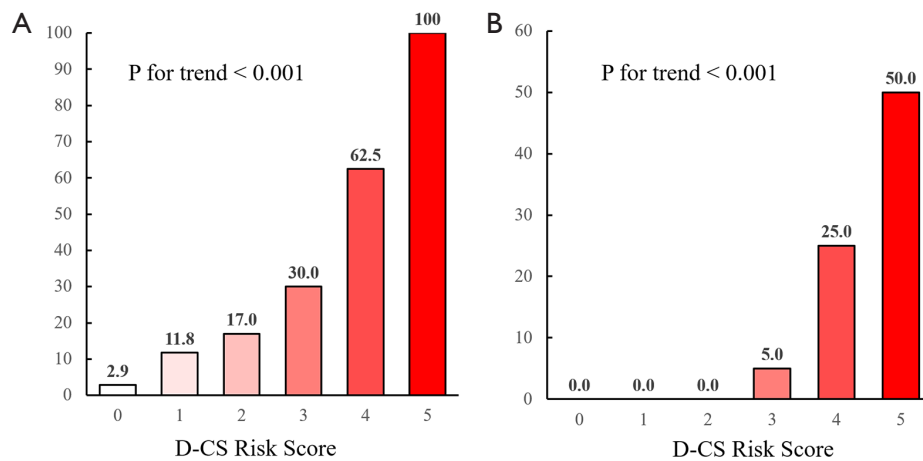

Figure S3 D-CS risk score, the frequency of D-CS and in-hospital mortality in the validation cohort. (A) Frequency of D-CS. (B) In-hospital morality. D-CS, deterioration of cardiogenic shock.

Figure S4 C-statistics for D-CS risk score in predicting D-CS and in-hospital mortality in the validation cohort. (A) Frequency of D-CS. (B) In-hospital mortality. D-CS, deterioration of cardiogenic shock; AUC, area under the curve; CI, confidence interval.
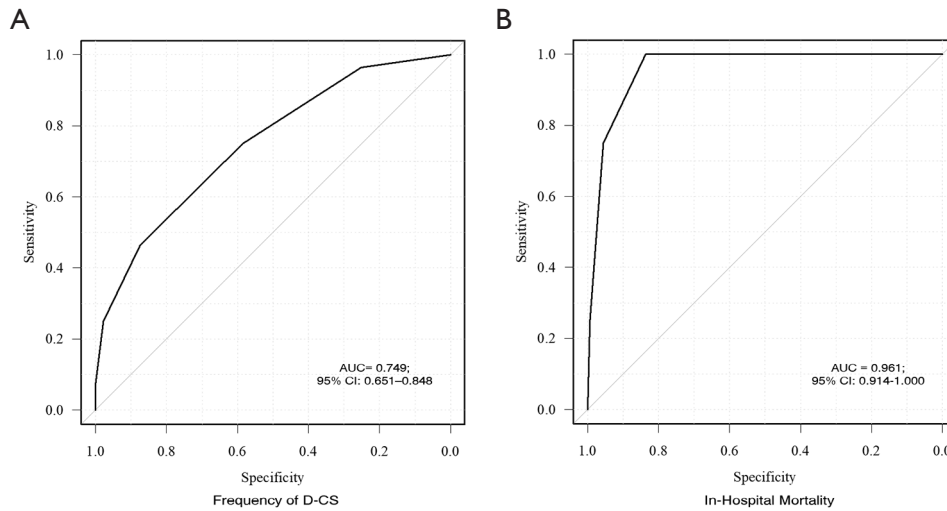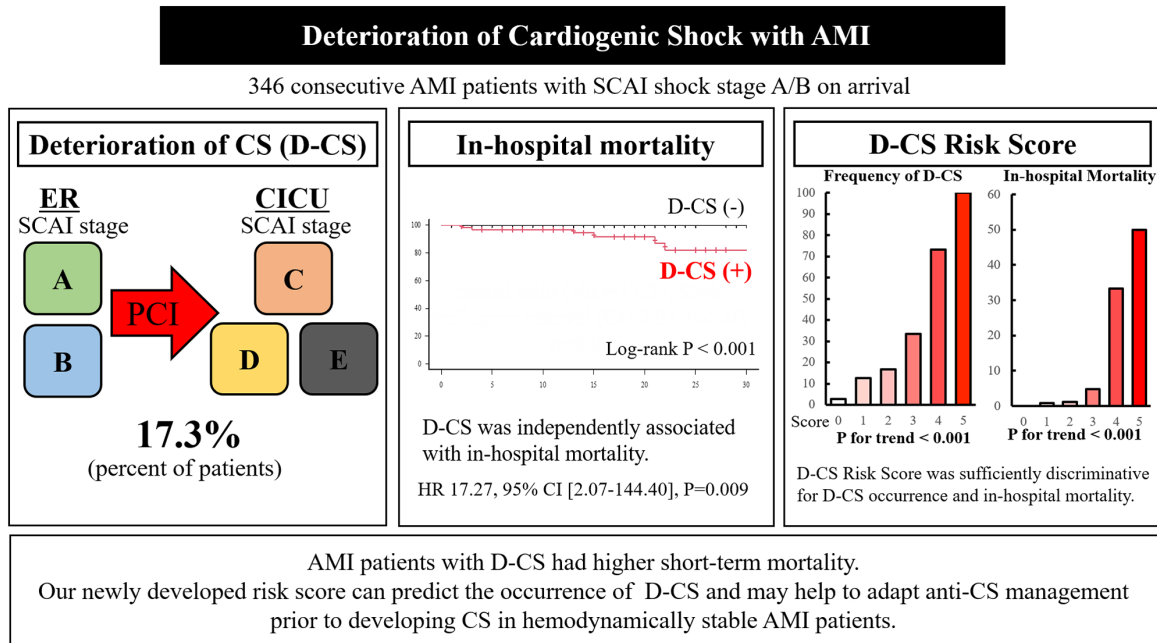

Figure S5 Summary figure. AMI, acute myocardial infarction; SCAI, Society of Cardiovascular Angiography and Intervention; D-CS, deterioration of cardiogenic shock; ER, emergency room; CICU, cardiac intensive care unit; PCI, percutaneous coronary intervention; HR, hazard ratio; CI, confidence interval.

Table S1 Univariate and multivariate Cox regression analyses about predictors of in-hospital mortality

Variables	Univariate analysis		Multivariate analysis	
	HR (95% CI)	P value	HR (95% CI)	P value
Age	1.01 (0.96–1.07)	0.65	–	–
Male	Inf (0.00–Inf)	0.99	–	–
eGFR	0.96 (0.93–1.00)	0.03	0.95 (0.91–0.99)	0.02
History of MI	1.83 (0.71–11.18)	0.13	–	–
History of CABG	2.38 (0.47–12.2)	0.29	–	–
History of stroke	2.07 (0.49–8.73)	0.32	–	–
Glucose	1.01 (1.00–1.01)	0.01	1.00 (0.99–1.00)	0.30
LAD	0.91 (0.25–3.21)	0.88	–	–
STEMI	0.85 (0.22–3.39)	0.82	–	–
Final TIMI flow grade <3	2.47 (0.46–13.10)	0.28	–	–
SCAI shock stage B in the ER	2.80 (0.76–10.31)	0.12	3.01 (0.77–11.68)	0.11
D-CS	17.27 (2.07–144.40)	0.009	12.95 (1.46–114.97)	0.02

HR, hazard ratio; CI, confidence interval; Inf, infinity; eGFR, estimated glomerular filtration rate; MI, myocardial infarction; CABG, coronary artery bypass graft; LAD, left anterior descending artery; STEMI, ST-segment elevation myocardial infarction; TIMI, Thrombolysis in Myocardial Infarction; SCAI, Society for Cardiovascular Angiography and Intervention; ER, emergency room; D-CS, deterioration of cardiogenic shock.

Table S2 Comparison of patients characteristics of SCAI shock stage A and B

Variables	SCAI shock stage A (n=306)	SCAI shock stage B (n=41)	P value
Age (years)	69.1±13.5	69.0±14.0	0.97
Male	239 (78.1)	32 (78.0)	>0.99
Hypertension	213 (69.6)	22 (53.7)	0.04
Dyslipidemia	229 (74.8)	24 (58.5)	0.07
Diabetes mellitus	79 (25.8)	14 (34.1)	0.25
CKD	62 (20.3)	15 (36.6)	0.02
History of MI	32 (10.5)	2 (4.9)	0.40
History of CABG	11 (3.6)	2 (4.9)	0.65
History of stroke	34 (11.1)	5 (12.2)	0.79
Severity of AMI			
STEMI	217 (70.9)	27 (65.9)	0.58
NSTEMI	89 (29.1)	14 (34.1)	0.58
OHCA	1 (0.3)	0 (0.0)	>0.99
LVEF (%)	55 [45, 60]	45 [35, 55]	0.001
Peak CK (IU/L)	1,134 [344, 2,703]	1,674 [682, 3,420]	0.07
Peak CK-MB (IU/L)	104 [26, 251]	135 [36, 316]	0.23
Hemodynamic measures in the ER			
Systolic BP (mmHg)	146.8±26.1	131.3±40.0	0.001
Diastolic BP (mmHg)	89.4±18.6	86.2±24.1	0.31
Heart rate (beats/min)	75.1±13.9	99.3±24.3	<0.001
Biochemical measures reflecting end-organ hypoperfusion in the ER			
Hemoglobin (g/dL)	14.2 [12.9, 15.3]	14.1 [11.9, 15.4]	0.30
Creatinine (mg/dL)	0.90 [0.76, 1.07]	1.13 [0.84, 1.50]	<0.001
eGFR (mL/min/m^2)	62.7 [50.5, 73.2]	49.9 [32.0, 60.8]	<0.001
BUN (mg/dL)	16.0 [13.0, 20.0]	19.0 [15.0, 28.0]	0.003
ALT (IU/mL)	22.0 [16.0, 35.0]	24.0 [17.0, 43.0]	0.31
Glucose (mg/dL)	132 [115, 166]	154 [119, 211]	0.06
BNP (pg/mL)	52.0 [18.2, 169.4]	136.8 [42.2, 509.9]	0.001
Arterial lactate (mmol/L)	1.3 [1.0, 1.4]	1.8 [1.6, 1.9]	0.04
pH	7.40 [7.37, 7.43]	7.38 [7.34, 7.43]	0.48
HCO$_3^-$ (mEq/L)	24.3 [22.4, 26.4]	22.5 [20.6, 23.3]	0.002
Location of culprit lesions			0.12
LMT	7 (2.3)	4 (9.8)	
LAD	135 (44.1)	20 (48.8)	
RCA	116 (37.9)	11 (26.8)	
LCx	27 (8.8)	3 (7.3)	
Chronic total occlusion	32 (10.5)	4 (9.8)	>0.99
Initial TIMI flow grade 0/1	156 (51.0)	23 (56.1)	0.61
Multivessel disease	202 (66.0)	20 (48.8)	0.03
PCI procedural characteristics			
Stent implantation	282 (92.2)	36 (87.8)	0.36
Final TIMI flow grade 3	300 (98.0)	38 (92.7)	0.07
Onset-to-reperfusion time (min)	246 [143, 462]	256 [164, 383]	0.64
Therapeutic management at CICU			
D-CS	47 (15.4)	13 (31.7)	0.01
Medication use			
Antiplatelet	69 (22.5)	8 (19.5)	0.84
ACE-I/ARB	103 (33.7)	9 (22.0)	0.15
β-blocker	55 (18.0)	4 (9.8)	0.26
Statin	89 (29.1)	8 (19.5)	0.26
Catecholamines			
Norepinephrine	4 (1.3)	7 (17.1)	<0.001
Dobutamine	8 (2.6)	7 (17.1)	0.001
Dopamine	0 (0.0)	2 (4.9)	0.01
MCS			
IABP	15 (4.9)	7 (17.1)	0.009
Impella	1 (0.3)	1 (2.4)	0.22
ECMO	4 (1.3)	2 (4.9)	0.15
Other therapies			
Mechanical ventilation	7 (2.3)	5 (12.2)	0.008
CRRT	5 (1.6)	4 (9.8)	0.01
Acute kidney injury[†]	3 (1.0)	3 (7.3)	0.02

Data are presented as mean ± standard deviation, n (%), or median [interquartile range]. [†], acute kidney injury was defined as an increase of creatinine level ≥0.3 mg/dL. SCAI, Society for Cardiovascular Angiography and Intervention; CKD, chronic kidney disease; MI, myocardial infarction; CABG, coronary artery bypass graft; AMI, acute myocardial infarction; STEMI, ST-segment elevation myocardial infarction; NSTEMI, non ST-segment elevation myocardial infarction; OHCA, out-of-hospital cardiac arrest; LVEF, left ventricular ejection fraction; CK, creatinine kinase; ER, emergency room; BP, blood pressure; eGFR, estimated glomerular filtration rate; BUN, blood urea nitrogen; ALT, alanine aminotransferase; BNP, brain natriuretic peptide; HCO$_3^-$, sodium bicarbonate; LMT, left main trunk; LAD, left anterior descending artery; RCA, right coronary artery; LCx, left circumflex artery; TIMI, Thrombolysis in Myocardial Infarction; PCI, percutaneous coronary intervention; CICU, cardiac intensive care unit; D-CS, deterioration of cardiogenic shock; ACE-I, angiotensin converting enzyme inhibitor; ARB, angiotensin receptor blocker; MCS, mechanical circulatory support; IABP, intra-aortic balloon pump; ECMO, extracorporeal membrane oxygenation; CRRT, continuous renal-replacement therapy.

Table S3 Univariate and multivariate analyses about D-CS prediction

Variables	Univariate analysis		Multivariate analysis	
	OR (95% CI)	P value	OR (95% CI)	P value
Age	0.98 (0.96–1.00)	0.05	0.97 (0.94–1.00)	0.07
Male	2.90 (1.20–7.04)	0.01	2.75 (0.99–7.62)	0.05
eGFR	0.99 (0.97–1.00)	0.03	0.98 (0.96–1.00)	0.07
History of MI	1.27 (0.53–3.07)	0.59	–	–
History of CABG	3.17 (1.00–10.10)	0.05	1.94 (0.25–14.89)	0.52
History of stroke	1.30 (0.57–3.00)	0.53	–	–
Glucose	1.01 (1.00–1.01)	<0.001	1.00 (1.00–1.01)	0.02
ALT	1.01 (1.00–1.01)	0.01	1.00 (0.99–1.01)	0.25
LMT	6.26 (1.84–21.26)	<0.001	5.17 (0.51–51.71)	0.16
LAD	1.19 (0.68–2.08)	0.53	1.22 (0.24–6.28)	0.80
LCx	0.31 (0.07–1.37)	0.12	0.72 (0.08–6.23)	0.77
RCA	0.70 (0.38–1.27)	0.24	0.54 (0.10–2.96)	0.48
STEMI	3.22 (1.47–7.04)	0.003	3.08 (1.21–7.84)	0.01
Chronic total occlusion	2.35 (1.09–5.09)	0.03	1.44 (0.47–4.38)	0.51
SCAI shock stage B in the ER	2.56 (1.24–5.30)	0.01	1.38 (0.56–3.39)	0.48
D-CS risk score ≥3	6.52 (3.48–12.20)	<0.001	4.37 (2.11–9.02)	<0.001

D-CS, deterioration of cardiogenic shock; OR, odds ratio; CI, confidence interval; eGFR, estimated glomerular filtration rate; MI, myocardial infarction; CABG, coronary artery bypass graft; ALT, alanine aminotransferase; LMT, left main trunk; LAD, left anterior descending; LCx, left circumflex artery; RCA, right coronary artery; STEMI, ST-segment elevation myocardial infarction; SCAI, Society for Cardiovascular Angiography and Intervention; ER, emergency room.

Table S4 Comparison of patients characteristics between derivation and validation cohorts

Variables	Derivation cohort (n=347)	Validation cohort (n=163)	P value
Age (years)	69.1±13.6	70.6±12.5	0.23
Male	271 (78.1)	117 (71.8)	0.12
Hypertension	235 (67.7)	117 (71.8)	0.34
Dyslipidemia	253 (72.9)	120 (73.6)	0.82
Diabetes mellitus	93 (26.8)	58 (35.6)	0.06
CKD	77 (22.2)	44 (27.0)	0.26
History of MI	34 (9.8)	13 (8.1)	0.62
History of CABG	13 (3.7)	5 (3.1)	0.80
History of stroke	39 (11.2)	14 (8.8)	0.43
Severity of AMI			
STEMI	244 (70.3)	113 (69.3)	0.83
NSTEMI	103 (29.7)	48 (29.4)	>0.99
OHCA	1 (0.3)	0 (0.0)	>0.99
LVEF (%)	50 [45, 60]	45 [40, 55]	0.11
Initial TIMI flow grade 0/1	179 (51.6)	81 (49.7)	0.70
Multivessel disease	222 (64.0)	101 (62.0)	0.69
SCAI CS stage A	306 (88.2)	133 (81.6)	0.06
SCAI CS stage B	41 (11.8)	30 (18.4)	0.06
D-CS	60 (17.3)	28 (17.2)	0.97
Hemodynamic measures in the ER			
Systolic BP (mmHg)	145.0±28.2	142.7±27.6	0.37
Diastolic BP (mmHg)	89.0±19.3	86.9±18.0	0.24
Heart rate (beats/min)	77.9±17.3	78.9±17.4	0.55
Catecholamines			
Norepinephrine	11 (3.2)	4 (2.5)	0.78
Dobutamine	15 (4.3)	5 (3.1)	0.62
Dopamine	2 (0.6)	1 (0.6)	>0.99
MCS			
IABP	22 (6.3)	12 (7.4)	0.70
Impella	2 (0.6)	1 (0.6)	>0.99
ECMO	6 (1.7)	5 (3.1)	0.34
Other therapies			
Mechanical ventilation	12 (3.5)	11 (6.7)	0.11
CRRT	9 (2.6)	1 (0.6)	0.18
Acute kidney injury[†]	6 (1.7)	5 (3.1)	0.33
D-CS	60 (17.3)	28 (17.2)	–

Data are presented as mean ± standard deviation, n (%), or median [interquartile range]. [†], acute kidney injury was defined as an increase of creatinine level ≥0.3 mg/dL. CKD, chronic kidney disease; MI, myocardial infarction; CABG, coronary artery bypass graft; AMI, acute myocardial infarction; STEMI, ST-segment elevation myocardial infarction; NSTEMI, non ST-segment elevation myocardial infarction; OHCA, out-of-hospital cardiac arrest; LVEF, left ventricular ejection fraction; TIMI, Thrombolysis in Myocardial Infarction; SCAI, Society for Cardiovascular Angiography and Intervention; CS, cardiogenic shock; D-CS, deterioration of cardiogenic shock; ER, emergency room; BP, blood pressure; MCS, mechanical circulatory support; IABP, intra-aortic balloon pump; ECMO, extracorporeal membrane oxygenation; CRRT, continuous renal-replacement therapy.