

Pre-arrest Physiological Status by National Early Warning Score and Neurological Outcomes after In-hospital Cardiac Arrest: A Multicenter Observational Study in Japan

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eTable 1. Baseline characteristics and arrest variables stratified by neurological outcome at hospital discharge.

Characteristic	All Patients (n = 1051)	CPC 1-2 (n = 221)	CPC 3-5/non-ROSC (n = 830)	P-value
Age (years)				<0.001
<65	242 (23.0)	77 (34.8)	165 (19.9)	
≥65	809 (77.0)	144 (65.2)	665 (80.1)	
The number of hospital beds				0.87
0 to 500	345 (32.8)	71 (32.1)	274 (33.0)	
501 to 1000	706 (67.2)	150 (67.9)	556 (67.0)	
CPC at admission				<0.001
1	685 (65.2)	191 (86.4)	494 (59.5)	
2	146 (13.9)	18 (8.1)	128 (15.4)	
3	121 (11.5)	4 (1.8)	117 (14.1)	
4	97 (9.2)	8 (3.6)	89 (10.7)	
5	2 (0.2)	0 (0)	2 (0.2)	
Days from admission to IHCA	5 [1–17]	2.5 [0–10]	6 [1–19]	<0.001
Patient level				0.005
Inpatient	895 (85.2)	184 (83.3)	711 (85.7)	
Outpatient	150 (14.3)	32 (14.5)	118 (14.2)	
Year of cardiac arrest				0.060
2016 to 2017	37 (3.5)	4 (1.8)	33 (4.0)	
2018 to 2019	400 (38.1)	97 (43.9)	303 (36.5)	
2020 to 2021	333 (31.7)	72 (32.6)	261 (31.4)	
2022 to 2023	281 (26.7)	48 (21.7)	233 (28.1)	
Event location				<0.001
Emergency department	100 (9.5)	16 (7.2)	84 (10.1)	
High care unit and stroke care unit	52 (4.9)	16 (7.2)	36 (4.3)	
Any intensive care unit	98 (9.3)	29 (13.1)	69 (8.3)	
Operating room	28 (2.7)	15 (6.8)	13 (1.6)	
Cardiac catheterization laboratory	69 (6.6)	30 (13.6)	39 (4.7)	
Out-patient area	30 (2.9)	9 (4.1)	21 (2.5)	
General wards ^a	591 (56.2)	84 (38.0)	507 (61.1)	

Characteristic	All Patients (n = 1051)	CPC 1-2 (n = 221)	CPC ROSC (n = 830)	3-5/non- P-value
Initial rhythm				<0.001
Asystole	253 (25.2)	30 (14.4)	223 (28.0)	
PEA	509 (50.6)	78 (37.3)	431 (54.1)	
Vf or pulseless VT	193 (19.2)	87 (41.6)	106 (13.3)	
Unknown	50 (5.0)	14 (6.7)	36 (4.5)	
NEWS	6 [3–9]	4 [2–6]	6 [4–9]	<0.001
Vital signs				
RR	20 [17–25]	18 [16–22]	20 [18–25]	<0.001
Missing	474 (45.1)	110 (49.8)	364 (43.9)	
SpO ₂	96 [94–98]	98 [96–99]	96 [94–98]	<0.001
Missing	286 (27.2)	50 (22.6)	236 (28.4)	
Body temperature	36.7 [36.4–37.2]	36.6 [36.3–37.0]	36.8 [36.4–37.2]	0.013
Missing	411 (39.1)	93 (42.1)	318 (38.3)	
Systolic blood pressure	112 [92–132]	120 [98.5–136]	109 [91–130]	<0.001
Missing	159 (15.1)	33 (14.9)	126 (15.2)	
Heart rate	90 [73–109]	80.5 [67.5–96]	92 [76–110]	<0.001
Missing	114 (10.8)	29 (13.1)	85 (10.2)	
Consciousness				<0.001
Alert	525 (56.2)	149 (75.3)	376 (51.1)	
Voice	191 (20.4)	21 (10.6)	170 (23.1)	
Pain	59 (6.3)	7 (3.5)	52 (7.1)	
Unresponsive	159 (17.0)	21 (10.6)	138 (18.8)	
Missing	117 (11.1)	23 (10.4)	94 (11.3)	

CPC cerebral performance category (CPC 1-2 indicates favorable neurological outcome, and CPC 3-5 indicates unfavorable outcome), IHCA in-hospital cardiac arrest, PEA pulseless electrical activity, Vf ventricular fibrillation, VT ventricular Tachycardia, NEWS National Early Warning Score, RR respiratory rate, SpO₂ peripheral oxygen saturation

Data are expressed as n (%) or median [interquartile range]. ^aGeneral wards include both monitored and unmonitored beds. The CPC 3-5/non-ROSC group included patients with a CPC score of 3-5 at hospital discharge and those who did not achieve return of spontaneous circulation.

eTable 2. Sensitivity analysis restricted to patients who achieved return of spontaneous circulation.

Variables	OR [95% CI]	P-value	aOR [95% CI]	P-value
Age (years) (<65 vs. ≥65)	2.04 [1.44–2.88]	<0.001	2.00 [1.29–3.10]	0.002
Sex (female vs. male)	1.03 [0.75–1.43]	0.85	1.21 [0.80–1.81]	0.36
OHCA (this admission vs. no)	0.89 [0.39–2.04]	0.78	2.38 [0.69–8.21]	0.17
Admission CPC 1–2 (vs. 3–4)	5.30 [2.87–9.82]	<0.001	5.70 [2.64–12.30]	<0.001
Day shift (vs. night shift)	1.90 [1.38–2.62]	<0.001	1.78 [1.20–2.66]	0.005
NEWS low risk (vs. high risk)	3.49 [2.39–5.09]	<0.001	3.33 [2.12–5.23]	<0.001
Witnessed arrest, yes (vs. no)	2.69 [1.43–5.06]	0.002	2.51 [1.15–5.50]	0.02
Bystander CPR, yes (vs. no)	1.39 [0.77–2.49]	0.27	1.18 [0.57–2.43]	0.65
ECG monitoring, yes (vs. no)	1.50 [0.99–2.27]	0.055	1.04 [0.60–1.78]	0.90
Shockable rhythm, yes (vs. no)	4.29 [2.95–6.22]	<0.001	2.14 [1.30–3.54]	0.003
Adrenaline dose (mg)	0.77 [0.67–0.90]	<0.001	0.83 [0.72–0.97]	0.02
CPR duration (min)	0.95 [0.93–0.96]	<0.001	0.97 [0.95–0.99]	0.002
Cardiac etiology, yes (vs. no)	3.82 [2.75–5.32]	<0.001	2.26 [1.42–3.57]	<0.001
Respiratory etiology, yes (vs. no)	0.32 [0.21–0.49]	<0.001	0.60 [0.36–1.00]	0.051

The sensitivity analysis was restricted to the 765 patients who achieved ROSC (CPC 1-2, n = 221; CPC 3-5, n = 544). Odds ratios were estimated using multiple imputation, and the multivariable model included the same covariates as in Table 2 of the main text.

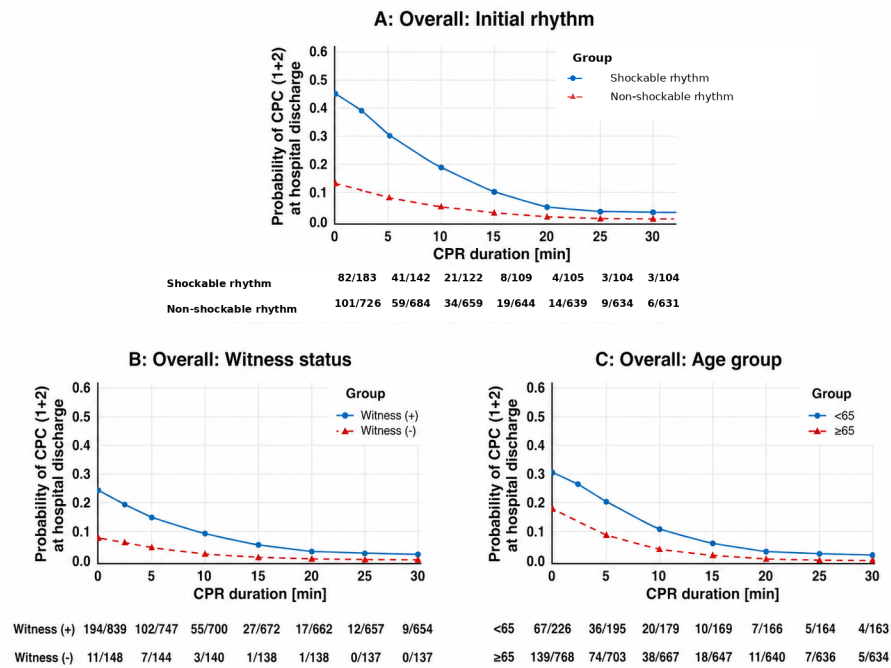
OR odds ratio, aOR adjusted odds ratio, CI confidence interval, OHCA out-of-hospital cardiac arrest, CPC cerebral performance category (CPC 1-2 indicates favorable neurological outcome, and CPC 3-5 indicates unfavorable outcome), NEWS National Early Warning Score, ROSC return of spontaneous circulation, CPR cardiopulmonary resuscitation, ECG electrocardiogram.

eTable 3. Complete-case univariable analysis of factors associated with favorable neurological outcome.

Variables	OR [95% CI]	P-value
Age (years) (<65 vs. ≥65)	2.53 [1.43–4.45]	0.001
Sex (female vs. male)	1.13 [0.65–1.92]	0.66
OHCA (this admission vs. no)	1.24 [0.18–5.51]	0.80
NEWS (per 1-point increase)	0.83 [0.77–0.90]	<0.001
NEWS low risk (vs. high risk)	3.63 [2.00–6.95]	<0.001
Witnessed arrest, yes (vs. no)	3.28 [1.27–11.18]	0.03
Shockable rhythm, yes (vs. no)	6.19 [3.49–11.11]	<0.001
Any defibrillation, yes (vs. no)	1.87 [1.05–3.27]	0.03
CPR duration (min)	0.90 [0.87–0.93]	<0.001

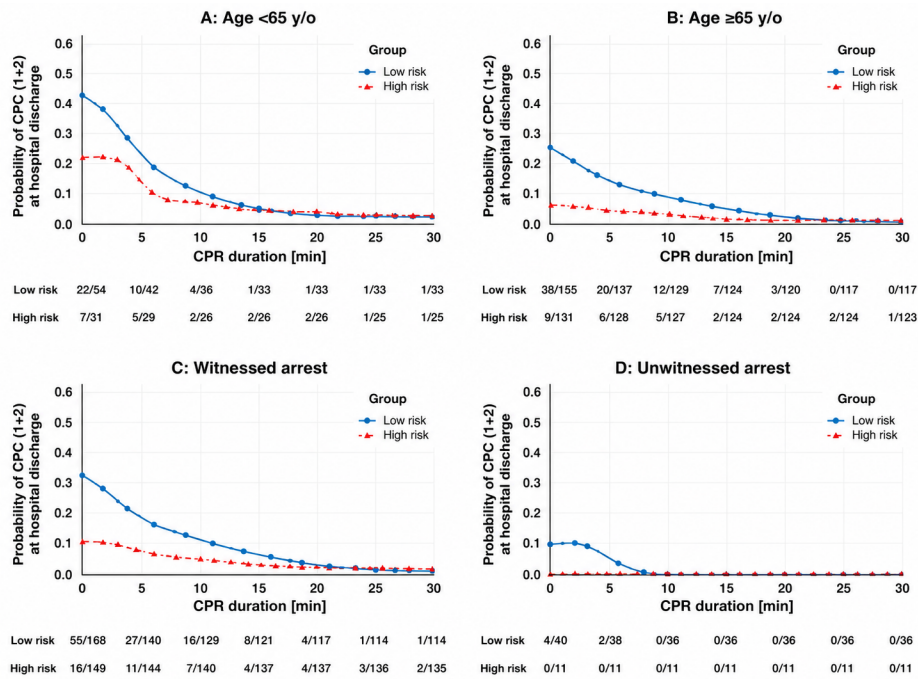
The complete-case univariable analysis was restricted to the 338 patients (72 with a favorable neurological outcome) who had complete data for all listed variables. Multivariable complete-case models were not constructed because the small number of events relative to the number of candidate variables would have yielded unstable estimates. The odds ratio for a low-risk NEWS (3.63; 95% CI 2.00–6.95) was consistent with the corresponding multiply imputed estimate (3.34; 95% CI 2.30–4.83), supporting the robustness of the multiple imputation.

OR odds ratio, CI confidence interval, OHCA out-of-hospital cardiac arrest, NEWS National Early Warning Score, CPR cardiopulmonary resuscitation.



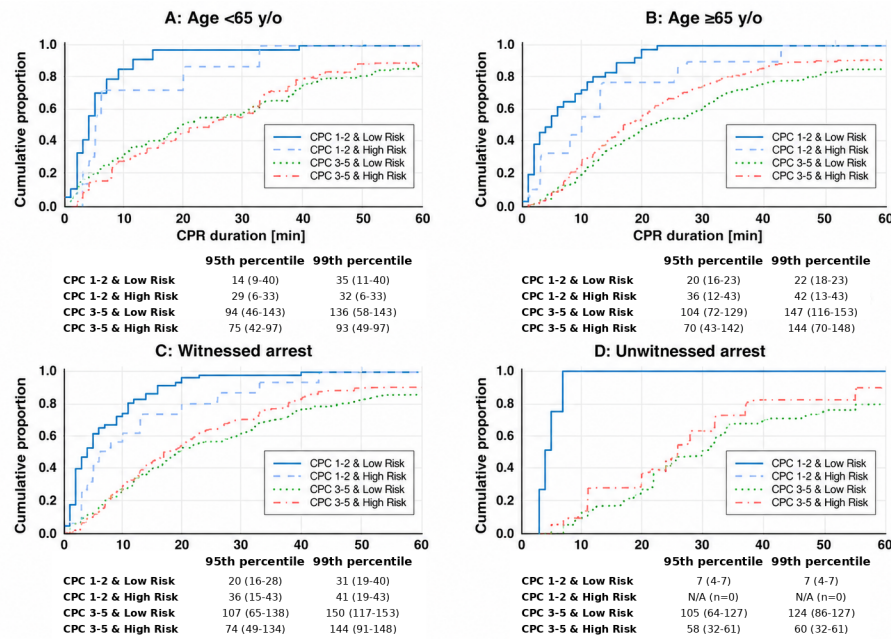
eFigure 1. Time-dependent probability of favorable neurological outcome according to cardiopulmonary resuscitation duration.

The probability of favorable neurological outcome (CPC 1–2 at hospital discharge) is plotted against cardiopulmonary resuscitation (CPR) duration. Analyses are stratified by (A) initial rhythm (shockable vs. non-shockable), (B) witness status (witnessed vs. unwitnessed), and (C) age group (≥ 65 vs. < 65 years). The curves represent the estimated probability of favorable neurological survival at each CPR duration. Numbers shown below each panel represent the number of patients with favorable neurological outcome over the number of patients at risk at the corresponding CPR duration.



eFigure 2. Time-dependent probability of favorable neurological outcome according to cardiopulmonary resuscitation duration stratified by risk group.

The probability of favorable neurological outcome (CPC 1–2 at hospital discharge) is plotted against cardiopulmonary resuscitation (CPR) duration. Analyses are stratified by (A) age <65 years, (B) age ≥65 years, (C) witnessed arrest, and (D) unwitnessed arrest. The curves represent the estimated probability of favorable neurological survival for the low-risk and high-risk groups at each CPR duration. Numbers shown below each panel represent the number of patients with favorable neurological outcome over the number of patients at risk at the corresponding CPR duration.



eFigure 3. Cumulative distribution of cardiopulmonary resuscitation duration according to neurological outcome and risk group.

Cumulative proportion of patients is plotted against cardiopulmonary resuscitation (CPR) duration. Analyses are stratified by (A) age <65 years, (B) age ≥65 years, (C) witnessed arrest, and (D) unwitnessed arrest. Curves represent the cumulative distribution of CPR duration for patients with favorable neurological outcome (CPC 1–2) and unfavorable neurological outcome (CPC 3–5) in the low-risk and high-risk groups. Values shown below each panel represent the 95th and 99th percentiles of CPR duration with corresponding ranges. The CPC 3–5 group includes patients who did not achieve return of spontaneous circulation.