Accidental Hypothermia: Factors Related to a Prolonged Hospital Stay - Nationwide Observational Study in Japan -

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Abstract

Background: Accidental hypothermia (AH) has a low frequency, and the length of hospital stay in patients with AH remains poorly understood. The present study explored which factors were related to long-term hospitalization among patients with AH using Japan's nationwide registry data.

Methods: The data from the Hypothermia STUDY 2018, which included patients ≥ 18 years old with a body temperature ≤ 35°C, were obtained from a multicenter registry for AH conducted at 89 institutions throughout Japan, collected from December 1, 2018, to February 28, 2019. The patients were divided into a "short-stay patients" group (within 7 days) and "long-stay patients" group (more than 7 days). A logistic regression analysis after multiple imputation was performed to obtain odds ratios (ORs) for prolonged hospitalization with age, frailty, cause of hypothermia, mechanism underlying hypothermia, temperature, pH, potassium level, and disseminated intravascular coagulation (DIC) score as independent variables.

Results: In total, 656 patients were included in the study, of which 362 were eligible for the analysis. The median length of hospital stay was 17 days. Of the 362 patients, 265 (73.2%) stayed in the hospital for more than 7 days. The factors associated with prolonged hospitalization were frailty (OR, 2.11; 95% confidence interval [CI], 1.09-4.10; $p = 0.027$), the occurrence of indoor (OR, 3.20; 95% CI, 1.58-6.46; $p = 0.001$), alcohol intoxication (OR, 0.17; 95% CI, 0.05-0.56; $p = 0.004$), pH (OR, 0.07; 95% CI, 0.01-0.76; $p = 0.029$), potassium level (OR, 1.36; 95% CI, 1.00-1.85; $p = 0.048$), and DIC score (OR, 1.54; 95% CI, 1.13-2.10; $p = 0.006$).

Conclusions: Frailty, indoor situation, alcohol intoxication, pH, potassium level, and DIC score were factors contributing to prolonged hospitalization in patients with AH. These factors can be valuable for the early detection of AH requiring a prolonged hospital stay.

Background

Accidental hypothermia (AH) is defined by a body core temperature of < 35 °C [1, 2]. While it has a low frequency, the mortality rate is high for cases of severe hypothermia[3, 4]. Previous studies regarding AH have shown that prognostic factors in patients with AH were the age, pH, and potassium level[3–7]. However, these factors were insufficient for predicting the long-term prognosis of patients with AH or prescribing prophylactic measures to prevent hypothermia. In contrast, studies focusing on the length of hospital stay have proven beneficial for preventing AH and considering the public health regarding AH. For instance, shortening hospitalization can increase the bed turnover rate, thereby reducing medical costs. However, few studies have investigated which factors are associated with the length of hospital stay [8].

The characteristics of patients with AH in Japan include an older age, high rate of occurring indoors, and high mortality rate [9] [10]. Japan is the most rapidly aging society in the world, so we believe that analyzing the AH registry in Japan will meaningfully influence the situation in other countries that are also experiencing the aging of their societies.

The present study investigated which factors are associated with long-term hospitalization in patients with AH using Japan's nationwide registry data of hypothermia.

Material And Methods

Study design and setting

We performed a prospective, observational, multi-center registry of hypothermia: the Hypothermia STUDY 2018. This study was conducted from December 1, 2018, to February 28, 2019, among a consortium of 89 academic and community medical centers from different geographic regions across Japan. The study was approved by the institutional review board of each hospital listed in the acknowledgements, and the requirement for informed consent was waived due to the observational nature of the study.

Patient selection and data collection

The present study included consecutive patients whose body temperature measured by emergency medical services (EMS) or at emergency department was less than 35 °C. Patients younger than 18 years old were excluded. The following data were collected: age, sex, any pre-existing conditions, activities of daily living, lifestyle, mechanism underlying hypothermia (acute medical illness, trauma [subimmersion, distress], alcohol intoxication, others [including drugs]), cause of hypothermia, Charlson comorbidity index, Glasgow coma scale (GCS), Sequential Organ Failure Assessment (SOFA) score [11], disseminated intravascular coagulation (DIC) score [12], laboratory data, temperature, dysrhythmias, cardiac arrest during pre-hospital, venous-arterial extracorporeal membrane oxygenation (V-A ECMO) rewarming, intubation, hospital periods, survival, and Cerebral Performance Category (CPC) score at 30 days after admission.

Acute medical illnesses were as follows: cerebrovascular disease, cardiac disease, infectious disease, undernutrition, epilepsy, renal disease, endocrine disease, gastrointestinal disease. The clinical frailty scale (CFS) score was determined using the activities of daily living and pre-existing conditions, as described previously [13]. Patients were defined as frail if they had a CFS score of ≥ 5 before hospital admission. Temperature was recorded as the core temperature from the rectum, urinary bladder, or esophagus if available; otherwise, the peripheral temperature from the axilla or ear was noted. Hypothermia was classified according to the temperature as mild (35 − 32 °C), moderate (32 − 28 °C), of severe (< 28 °C).

The laboratory data included the pH, potassium level, platelet count, and CPK level at the emergency department. The pH value in principle was evaluated by an arterial blood gas analysis, and the pH measured using the venous blood gas was adjusted as described in a previous study [14]. Complications during hospitalization were recorded and classified as pneumonia, pancreatitis, or other. Pneumonia was defined as an obvious shadow on chest radiography or computed tomography (CT). Pancreatitis was defined as cases meeting at least two of the following conditions: 1) abdominal pain, 2) elevation of pancreatic enzyme levels in the blood, and 3) edema of the pancreas or peripancreatic effusion on ultrasound/CT. In the present study, patients were excluded from the analysis if they were 30-day non-survivors, lacked a hospital stay, or had an unknown length of hospital stay or an unknown body temperature, as these patients had potential biases.

Previous studies showed that the median length of hospital stay in patients with AH was 4–9 days [10] [4] [8]. We therefore divided the patients with AH into 2 groups: the “short-stay patients” group (≤ 7 days) and “long-stay patients” group (> 7 days).

Data analyses

Data are expressed as the number (%) or median (interquartile range), as appropriate. Intergroup comparisons were made using Fisher’s exact test for categorical data and the Mann-Whitney U test for continuous data. For a further evaluation, we conducted multivariate logistic regression analyses to control for the potentially confounding roles of age, frailty, cause of hypothermia, mechanism underlying hypothermia, temperature, pH, potassium, and DIC score. These potential confounders were selected based on a previous study regarding AH [8] or the consideration of clinically significant variables. Furthermore, a multiple linear regression analysis including similar variables was performed. Missing data were managed with multiple imputation by chained equations [15, 16]. The variables included in the imputation model were those from the logistic regression analysis. Twenty-five dataset were imputed with 10 iterations each. Multivariate logistic regression and multiple liner regression analyses were applied to the 25 imputed datasets, and final estimates were obtained by averaging the 25 estimates according to Rubin’s rules. Furthermore, a complete data set was used for the sensitive analysis. All tests were two-sided with P values of less than 0.05 considered statistically significant.

Statistical analyses were performed with the EZR software program (Saitama Medical Center, Jichi Medical University, Saitama, Japan), a graphical user interface for R software. Multiple imputation was performed using mice package in the R software program, version 4.0.1 (R Foundation for Statistical Computing, Vienna, Austria).

Results

Of the 656 patients with hypothermia included in the Hypothermia STUDY 2018, 294 were excluded from the present study because of death within 30 days (N = 160), non-hospital stay (N = 110), unknown length of hospital stay (N = 21), or others, including an unknown temperature (N = 3). The remaining 362 patients were eligible for the present analysis. The patient flow diagram is shown in Fig. 1. Depending on the length of hospital stay, the 362 patients were divided into the “short-stay patients” group (N = 97) and “long-stay patients” group (N = 265). The overall mortality rate within 30 days was 160 among 656 patients (24.4%). Among the remaining 362 patients, 265 (73.2%) stayed in the hospital for more than 7 days.

Baseline characteristics of the study population

Table 1 shows the baseline characteristics of the study population and a comparison of the clinical characteristics between the “short-stay patients” and “long-stay patients” groups. The median patient age was 78 years old, and 75.1% of AH cases occurred indoors. The age, SOFA score, and DIC score were higher in the “long-stay patients” group than in the “short-stay patients” group. There was a significant difference in the CFS score, cause of hypothermia, and mechanism of hypothermia between the “short-stay patients” and “long-stay patients” groups. In the “long-stay patients” group, the rate of occurrence indoors was higher than that in the “short-stay patients” group. Regarding the cause of hypothermia, acute illness was the predominant cause in the “long-stay patients” group, whereas the proportion of cases caused by alcohol intoxication was higher in “short-stay patients” group than in the “long-stay patients” group.

Clinical and laboratory data

The clinical and laboratory data are presented in Table 2. There were no significant differences in the severity grade of temperature, GCS, blood pressure, heart rate, respiratory rate, platelet level, or rate of intubation between the “short-stay patients” and “long-stay patients” groups. However, the pH values were significantly lower and the potassium and CPK levels higher in the “long-stay patient” group than in the “short-stay patient” group. In addition, the “long-stay patient” group showed a significantly higher incidence of arrhythmia than the “short-stay patient” group. A total of 222 (61.3%) patients were admitted to the intensive-care unit (ICU), although there was no significant difference in the rate of ICU admission between the groups.

Complications, neurological score, and hospital length of stay

There was no significant difference in the incidence of complications between the “short-stay patients” and “long-stay patients” groups (Table 3). However, at the neurological assessment, the “long-stay patients” group showed a higher rate of worsened neurological score (CPC 3–5) at 30 days after admission than the “short-stay patients” group, while the “short-stay patients” group showed a significantly higher rate of patients with a favorable neurological outcome (CPC 1–2) than the “long-stay patients” group. The median length of ICU stay was 4 days, and the median length of hospital stay was 17 days for the 362 total patients. Additional file 1 shows the distribution of the hospital stay duration.

Multivariate logistic regression analyses

Table 4 shows that the factors associated with the length of hospital stay, based on a multivariate logistic regression analysis after multiple imputation, were frailty (odds ratio [OR], 2.11; 95% confidence interval [CI], 1.09– 4.10; p = 0.027), indoor occurrence (OR, 3.20; 95% CI, 1.58–6.46; p = 0.001), mechanism underlying hypothermia (alcohol intoxication) (OR, 0.17; 95% CI, 0.05–0.56; p = 0.004), pH (OR, 0.07; 95% CI, 0.01–0.76; p = 0.029), potassium levels (OR, 1.36; 95% CI, 1.00-1.85; p = 0.048), and the DIC score (OR, 1.54; 95% CI, 1.13–2.10; p = 0.006). In the sensitivity analysis, pH (OR, 0.10; 95% CI, 0.01–1.11, p = 0.061) was not significantly associated with the length of hospital stay, but the result was close to significance, and the sensitivity analysis showed similar results to the analysis after multiple imputation. Thus, the results of the analysis after multiple imputation were considered robust.

Multiple liner regression analyses

Table 5 shows the correlation between variables and the length of hospital stay, based on a multiple liner regression analysis after multiple imputation. Indoor occurrence (β = 7.19; 95% CI, 1.14–13.24, P = 0.020), mechanism underlying hypothermia (alcohol intoxication) (β = -10.82; 95% CI, -20.92–0.71, P = 0.036), and the DIC score (β = 2.84; 95% CI, 0.41–5.28, P = 0.022) were significantly correlated with the length of hospital stay. In the sensitivity analysis, alcohol intoxication (β = -8.95; 95% CI, -20.82-2.91, p = 0.139) was not significantly associated with the length of hospital stay, but the result was close to significance, so the interpretation of results did not make much difference. Thus, the results of the analysis after multiple imputation were considered robust.

Discussion

The present nationwide study showed that a total of 75.1% of patients with AH developed AH indoors. A total of 73.2% of patients with AH stayed in hospitals for more than 7 days. The median length of hospital stay was 17 days. The rate of complications was low, there was no association between complications and the length of hospital stay. The factors related to long-term hospitalization were frailty, indoor occurrence, alcohol intoxication, pH, potassium levels, and the DIC score.

Among these factors related to a prolonged hospital stay, the pH, potassium levels, and DIC score were not preventable, while frailty and an indoor occurrence were potentially preventable with intervention. Previous studies have shown many patients with AH in urban settings develop AH indoors [9] [10], which was in agreement with the present findings. In addition, the patients who develop AH indoors have a higher death rate and longer hospital stay because of their tendency to have an advanced age [17] [10]. However, of note, the present study showed that the factors associated with the length of hospital stay were not just the age but the frailty. Recently, frailty, which is highly prevalent in older individuals and confers a high risk of falls, disability, hospitalization, and mortality [18], has also been noted in critically ill patients [19] [20]. To our knowledge, limited data exist regarding the relationship between AH and frailty. The present findings are of critical importance. Clinically, the risk factors of frailty and an indoor occurrence may be useful for the early detection of AH patients likely to require a prolonged hospital stay. In the future, preventing frailty and maintaining adequate activities of daily living may help suppress the occurrence of AH and reduce the length of hospital stay. This approach is certain to have an incredible impact on the aging populations of Japan as well as other industrialized countries.

In the present study, alcohol intoxication, pH, potassium levels, and the DIC score were shown to be associated with length of hospital stay. In general, the DIC score is increased by sepsis and organ failure. Accordingly, AH patients complicated by such issues may have a significantly prolonged hospital stay. Alcohol intoxication was conversely associated with a short hospital stay. We speculate that these patients had acute alcohol intoxication, which resulted in an early discharge from the hospital after rewarming and awakening. However, a previous study showed that a lower core temperature, lower degree of consciousness, and lower platelet count were associated with a prolonged hospital stay, although these factors were not found to be associated in the present study. Several reasons may explain this discrepancy. First, the previous study differed from the present study with regard to the patient background. Previous studies regarding AH patients from Europe and North Europe showed that these patients were mostly healthy, younger individuals, and AH occurred outdoors, such as in cases of avalanche or submersion in freezing water [3, 21, 22], resulting in an early discharge from the hospital. In contrast, the patients in the present study were older individuals with underlying diseases, and AH tended to occur indoors. These differences may affect the factors associated with the hospital stay. Second, the previous study was performed at a single institution and extracted from a univariate analysis, so potential confounders were not considered for adjustment. The present study was a multicenter, nationwide study associated with AH in Japan and involved a multivariate analysis of credible data.

The present study had several limitations. First, the length of hospitalization is influenced by the social environment and medical care system. Therefore, it may be not appropriate to compare the results of this study with those from other countries. Second, this registry did not include data on the CFS score, and instead, the CFS score was evaluated using the activities of daily living and pre-existing conditions. As a result, the frailty not have been accurately classified. Finally, although we adjusted for variables, the possibility of residual confounding factors cannot be avoided.

Conclusions

This study found, that among patients with AH, three-quarters needed to be hospitalized for more than 7 days. The factors related to a prolonged hospital stay were frailty, indoor occurrence, pH, potassium levels, and the DIC score. Conversely, alcohol intoxication was associated with a short hospital stay. Taken together, these findings suggest that reducing frailty and maintaining adequate activities of daily living may help reduce the length of hospital stay in patients with AH. This is certain to influence the outcomes of aging populations in Japan as well as other industrialized countries.

Abbreviations

AH: Accidental hypothermia, ORs: odds ratios, CI: confidence interval, DIC: disseminated intravascular coagulation, EMS: emergency medical services, GCS: Glasgow coma scale, SOFA: Sequential Organ Failure Assessment, V-A ECMO: venous-arterial extracorporeal membrane oxygenation, CPC: Cerebral Performance Category, CFS: clinical frailty scale, CT: computed tomography, CPA: cardiopulmonary arrest, ECG: electrocardiogram, ED: emergency department, VF: ventricular fibrillation, PEA: pulseless electrical activity, ICU: intensive-care unit

Declarations

Acknowledgements:

List of hospitals participating in the present study

Aizawa Hospital

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Asahikawa Medical University Hospital

Center Hospital of the National Center for Global Health and Medicine

Daiyukai General Hospital

Dokkyo Medical University Nikko Medical Center

Dokkyo Medical University Saitama Medical Center

Esashi Hospital

Fujieda Municipal General Hospital

Fujisawa City Hospital

Fukui Prefectual Hospital

Funabashi Municipal Medical Center

Gifu Prefectual General Medical Center

Gifu University Hospital

Hamamatsu Medical Center

Hidaka Tokushukai Hospital

Hokkaido Medical Center

Hyogo Emergency Medical Center

Hyogo Prefectual Nishinomiya Hospital

Ina Central Hospital

Ise Red Cross Hospital

Ishikawa Prefectual Central Hospital

Ishinomaki Red Cross Hospital

Iwata City Hospital

Iwate Prefectual Central Hospital

Japanese Red Cross Society Kyoto Daiichi Hospital

Juntendo University Nerima Hospital

Juntendo University Urayasu Hospital

Kagawa University Hospital

Kansai Medical University Hospital

Kasugai Municipal Hospital

Kawaguchi Municipal Medical Center

Kawasaki Municipal Hospital

Kimitsu Chuo Hospital

Kumamoto Red Cross Hospital

Kyorin University Hospital

Kyoto University Hospital

Mie Prefectual Genaral Medical Center

Miyazaki Prefectual Nobeoka Hospital

Nagano Red Cross Hospital

Nagasaki University Hospital

Nagoya Ekisaikai Hospital

Nagoya University Hospital

Narita Red Cross Hospital

Nasu Red Cross Hospital

National Defense Medical College Hospital

National Hospital Organization Mito Medical Center

National Hospital Organization Nagoya Medical Center

National Hospital Organization Osaka National Hospital

Nayoro City General Hospital

Nihon University Hospital

Nihon University Itabashi Hospital

Nihonkai General Hospital

Niigata University Medical & Dental Hospital

Nippon Medical School Hospital

Nippon Medical School Tamanagayama Hospital

Oita University Hospital

Ome Municipal Central Hospital

Osaka City General Hospital

Ota Memorial Hospital

Rinku General Medical Center

Saiseikai Shiga Hospital

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Sapporo City General Hospital

Seirei Hamamatsu General Hospital

Seirei Mikatahara General Hospital

Shinshu University Hospital

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Tokushima Prefectual Miyoshi Hospital

Tokuyama Central Hospital

Tokyo Metropolitan Tama Medical Center

Tosei General Hospital

Toyama University Hospital

Tsuyama Chuo Hospital

University of Tokyo Hospital

University of Yamanashi Hospital

Yamagata University Hospital

Yamaguchi University Hospital

Yamanashi Prefectual Central Hospital

Yokkaichi Municipal Hospital

Yokohama Minami Kyosai Hospital

Authors' contributions:

ST and JK contributed to the conception and design of this analysis. ST wrote the manuscript. TH, SY, YK, KH, and JS supervised the work. YS provided statistical advice on the study design and the analyzed data. TM, MY, JY, YO, YO, HK, TK, MF, KS, HY, and AY contributed to the interpretation of the results. All authors read and approved the final manuscript.

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Not applicable

Competing interests:

The authors declare that they have no competing interests.

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Tables

Table 1.
Characteristics of patients with hypothermia

	All patients	Missing	Short-stay patients	Long-stay patients	p-value
	n = 362	n, (%)	n = 97	n = 265	
Age, years	78 (68–87)	0	75 (62–86)	79 (69–87)	0.035
Males	197 (54.4%)	0	51 (52.6%)	146 (55.1%)	0.721
Charlson comorbidity index	1 (0–1)	0	1 (0–1)	1 (0–2)	0.341
Severity					
SOFA total	4 (2–7)	29 (8.0)	3 (2–5)	5 (3–7)	< 0.001
DIC score	2 (1–3)	1 (0.0)	2 (1–2)	2 (1–3)	< 0.001
Clinical Frailty Scale score		11 (3.0)			0.009
1: very fit	93 (25.7%)		32 (34.0%)	61 (23.7%)	
2: well	115 (31.8%)		30 (31.9%)	85 (33.1%)	
3: well with treated comorbid disease	21 (5.8%)		6 (6.4%)	15 (5.8%)	
4: apparently vulnerable	45 (12.4%)		2 (2.1%)	43 (16.7%)	
5: mildly frail	47 (13.0%)		17 (18.1%)	30 (11.7%)	
6: moderately frail	13 (3.6%)		4 (4.3%)	9 (3.5%)	
7: severely frail	17 (4.7%)		3 (3.2%)	14 (5.4%)	
Lifestyle		8 (2.2)			0.866
Living alone	128 (36.2%)		30 (32.3%)	98 (37.5%)	
Not living alone	210 (59.3%)		59 (63.4%)	151 (57.9%)	
Homelessness	1 (0.3%)		0 (0.0%)	1 (0.4%)	
Nursing home	10 (2.8%)		3 (3.2%)	7 (2.7%)	
Unknown	5 (1.4%)		1 (1.1%)	4 (1.5%)	

Location		16 (4.4)			< 0.001
Outdoor	86 (24.9%)		40 (42.6%)	46 (18.3%)	
Indoor	260 (75.1%)		54 (57.4%)	206 (81.7%)	
Mechanism underlying hypothermia		21 (5.8)			< 0.001
Acute medical illness	192 (53.0%)		35 (39.8%)	157 (62.1%)	
Trauma, Subimmersion, and distress	53 (14.6%)		15 (17.0%)	38 (15.0%)	
Alcohol intoxication	22 (6.1%)		16 (18.2%)	6 (2.4%)	
Others (Unknown, drug)	74 (20.4%)		22 (25.0%)	52 (20.6%)	

SOFA, Sequential Organ Failure Assessment; DIC, disseminated intravascular coagulopathy
The data are expressed as the number (%) or median (interquartile range).

Table 2.
Clinical and laboratory data of patients with hypothermia

	All patients	Missing	Short-stay patients	Long-stay patients	p-value
	n = 362	n, (%)	n = 97	n = 265	
Temperature	30.8 (28.5–33.2)	0	31.8 (29.4–33.7)	30.6 (28.2–33.1)	0.036
Mild (35–32 °C)	143 (39.5%)		47 (48.5%)	96 (36.2%)	0.089
Moderate (32–28 °C)	144 (39.8%)		35 (36.1%)	109 (41.1%)	
Severe (< 28 °C)	75 (20.7%)		15 (15.5%)	60 (22.6%)	
GCS	11 (9–14)	14 (3.9)	13 (9–14)	11 (8–14)	0.086
Systolic BP (mmHg)	120 (96–146)	25 (6.9)	126 (98–153)	119 (95–142)	0.197
Diastolic BP (mmHg)	71 (55–89)	30 (8.3)	76 (60–90)	70 (52–87)	0.115
Heart rate	70 (54–91)	7 (1.9)	73 (56–93)	70 (53–90)	0.474
Respiratory rate	18 (15–22)	27 (7.5)	17 (14–20)	18 (15–22)	0.106
pH	7.32 (7.21–7.37)	48 (13.3)	7.34 (7.27–7.39)	7.31 (7.21–7.37)	0.018
Potassium (mEq/L)	4.2 (3.6–4.9)	7 (1.9)	3.9 (3.5–4.4)	4.3 (3.7–5.0)	0.001
Plt (× 10^4/μL)	18.7 (13.1–25.3)	7 (1.9)	19.5 (14.1–25.5)	18.4 (12.5–24.8)	0.328
CPK (U/L)	378 (157–1210)	26 (7.2)	219 (118–593)	459 (180–1409)	< 0.001
ECG at ED		19 (5.3)			0.001
Normal	147 (40.6%)		54 (59.3%)	93 (36.9%)	
Abnormal	196 (54.1%)		37 (40.7%)	159 (63.1%)	
CPA	13	0	0	13	0.024
Intubation	47	20 (5.5)	8	39	0.153
V-A ECMO	9	0	0	9	0.120
Admitted to ICU	222 (61.3%)	0	52 (53.6%)	170 (64.2%)	0.088

GCS, Glasgow Coma Scale; ECG, electrocardiogram; ED, emergency department; CPA, cardiopulmonary arrest; ECMO, extracorporeal membrane oxygenation
The data are expressed as the number (%) or median (interquartile range).

Table 3.
Complications, neurological score and hospital length of stay

	All patients	Short-stay patients	Long-stay patients	p-value
	n = 362	n = 97	n = 265	
Length of stay in the ICU	4 (2–7)	2 (2–3)	5 (3–9)	< 0.001
Length of stay in the hospital	17 (7–32)	4 (2–6)	24 (14–38)	< 0.001
CPC at 30 days				0.008
good (1–2)	167	45	122	
poor (3–5)	72	9	67	
Complications				0.768
None	357	97	260	
Pneumonia	1	0	1	
Pancreatitis	1	0	1	
Other	3	0	3	
Complications of arrhythmia				1.000
None	354	96	258	
VF	2	0	2	
PEA	1	0	1	
Bradycardia	4	1	3	
Other	1	0	1	

VF, ventricular fibrillation; PEA, pulseless electrical activity; ICU, intensive-care unit
The data are presented as the median (interquartile range).

Table 4.
Results of a multivariate logistic regression analysis for factors associated with the length of hospital stay

Variables	Model without imputation (N = 281)			Model with imputation (N = 362)		
	OR	95% CI	P-value	OR	95% CI	P-value
Age, years	1.02	0.99–1.05	0.069	1.02	0.99–1.04	0.103
Frailty (CFS ≥ 5)	2.59	1.19–5.63	0.017	2.11	1.09–4.10	0.027
Location						
Outdoor	Reference		–	Reference		–
Indoor	3.57	1.55–8.23	0.003	3.20	1.58–6.46	0.001
Mechanism causing hypothermia						
Acute medical illness	Reference		–	Reference		–
Trauma, Subimmersion, and distress	0.88	0.32–2.45	0.804	0.95	0.40–2.28	0.913
Alcohol intoxication	0.20	0.05–0.73	0.015	0.17	0.05–0.56	0.004
Others (Unknown, drug)	0.72	0.34–1.55	0.408	0.68	0.34–1.34	0.263
Temperature (per 1°C)	0.97	0.87–1.07	0.510	0.96	0.87–1.05	0.330
pH (per 1)	0.10	0.01–1.11	0.061	0.07	0.01–0.76	0.029
Potassium (per 1 mEq/L)	1.45	1.02–2.07	0.039	1.36	1.00–1.85	0.048
DIC score (per 1)	1.83	1.24–2.69	0.002	1.54	1.13–2.10	0.006
OR, odds ratio; CI, confidence interval; DIC, disseminated intravascular coagulopathy; ED, emergency department						

Table 5.
Results of a multiple linear regression analysis for factors associated with the length of hospital stay

	Model without imputation (N = 281)				Model with imputation (N = 362)			
	Partial regression coefficient β	95% CI			Partial regression coefficient β	95% CI		
		Lower	Upper	P-value		Lower	Upper	P-value
Age, years	0.04	-0.16	0.24	0.705	0.02	-0.15	0.19	0.845
Frailty (CFS ≥ 5)	5.22	-1.41	11.84	0.122	3.81	-1.78	9.39	0.181
Location								
Outdoor	Reference			–	Reference			–
Indoor	8.75	1.45	16.06	0.019	7.19	1.14	13.24	0.020
Mechanism causing hypothermia								
Acute medical illness	Reference			–	Reference			–
Trauma, Subimmersion, and distress	5.77	-2.91	14.46	0.192	3.31	-3.70	10.31	0.354
Alcohol intoxication	-8.95	-20.82	2.91	0.139	-10.82	-20.92	-0.71	0.036
Others (Unknown, drug)	1.39	-5.09	7.88	0.673	-0.29	-5.96	5.37	0.919
Temperature (per 1°C)	-0.56	-1.45	0.34	0.222	-0.54	-1.30	0.22	0.166
pH (per 1)	-12.65	-30.11	4.80	0.155	-15.63	-31.98	0.72	0.061
Potassium (per 1 mEq/L)	0.64	-1.83	3.10	0.611	0.55	-1.67	2.77	0.629
DIC score (per 1)	4.07	1.08	7.07	0.008	2.84	0.41	5.28	0.022

CI, confidence interval; DIC, disseminated intravascular coagulopathy; ED, emergency department

Figures

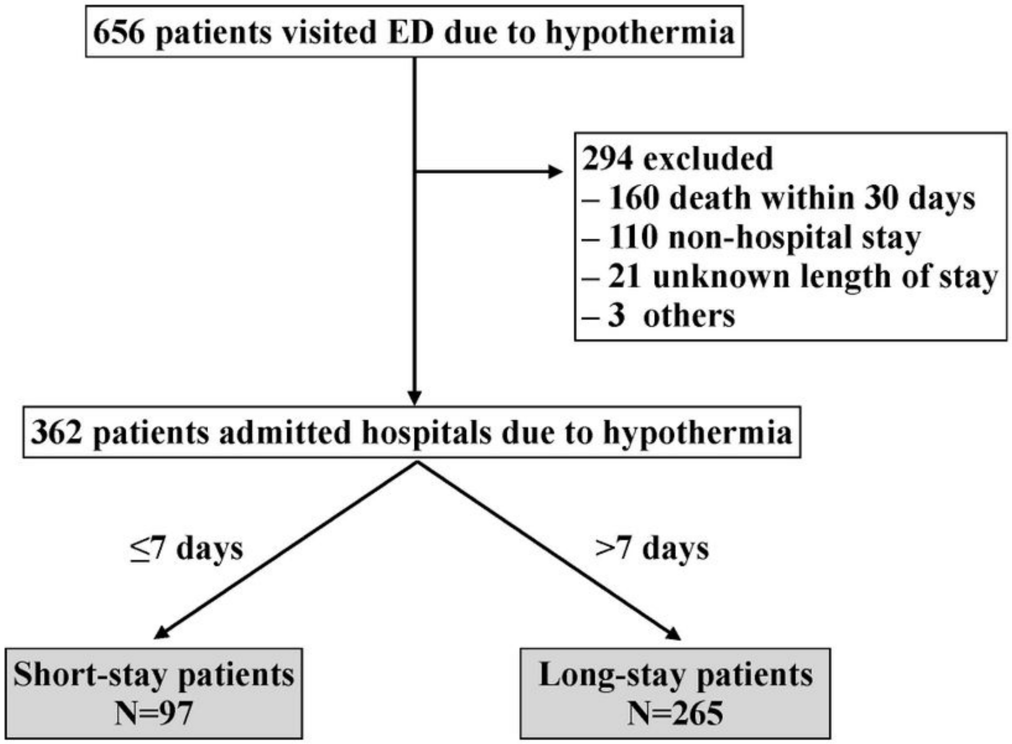

Figure 1

Study flowchart. ED, emergency department

Supplementary Files

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- SuppFigure120200915.pdf