American Journal of Emergency Medicine (2008) **26**, 683–688

ELSEVIER

The American Journal of Emergency Medicine

www.elsevier.com/locate/ajem

Original Contribution

Hypothermia in a desert climate: severity score and mortality prediction

Gabby Elbaz MD[a,1], Ohad Etzion MD[b,1], Jorge Delgado MD[b], Avi Porath MD[b], Daniel Talmor MD, MPH[c], Victor Novack MD, PhD[b,d,*]

[a]*Department of Internal Medicine, Asaf-Harofeh, Rechovot, 20300 Beer-Sheva, Israel*
[b]*Department of Internal Medicine, Soroka University Medical Center, 84101 Beer-Sheva, Israel*
[c]*Department of Anesthesia, Critical Care and Pain Medicine, Beth Israel Deaconess Medical Center, Boston, MA 02215, USA*
[d]*Harvard Clinical Research Institute, Boston, MA 02215, USA*

Received 24 September 2007; revised 12 October 2007; accepted 14 October 2007

Abstract

Introduction: The goal of our study was to characterize patients admitted to the hospital with hypothermia in a desert climate.

Methods: This was a retrospective study (1999-2005) in a 1200-bed tertiary care hospital in southern Israel. Patients' data and weather condition (including mean day high and low temperatures, humidity, wind velocity and precipitation) within 48 hours before admission were assessed.

Results: One hundred sixty-nine patients with hypothermia were admitted. The mean highest environmental temperature over 48 hours before admission was 15.3°C in the severe hypothermia (9 cases, 5.3%), 21.4°C in the moderate (40 cases, 23.7%), and 29.3°C in the mild group (120 cases, 71.0%). Major medical conditions associated with decreased body temperature were sepsis (65, 38.5%), trauma (34, 20.1%), endocrine disorders (19, 11.2%), and substance abuse (15, 8.9%). The inhospital mortality rate was 47.3%. A risk score based on 5 admission variables (age ≥70 years, mean arterial pressure <90 mm Hg, pH <7.35, creatinine >1.5 mg/dL, and confusion) was generated, predicting inhospital mortality with area under the receiver operating characteristic (ROC) curve of 0.81 (95% confidence interval, 0.75-0.87).

Conclusions: Hypothermia should not be overlooked in geographical areas with temperate climates. Using a prognostication system based upon clinical and laboratory variables may identify hypothermia patients with increased risk of death.

1. Background

Hypothermia, defined as a reduction in the body's core temperature to less than 35°C [1], is a well-known thermoregulatory disorder since ancient times. One of the first documented references of hypothermia in Israel appears in the Bible: "King David was now old, advanced in years; and though they covered him with bedclothes, he never felt warm" [2].

In recent years, hypothermia has been increasingly recognized as a significant problem in clinical practice [3,4]. Between 1979 and 2002, a total of 16 555 deaths in the United States, an average of 689 per year, were attributed to

* Corresponding author. Harvard Clinical Research Institute, Boston, MA, USA. Tel.: +1 617 632 1367.

E-mail address: victor.novack@hcri.harvard.edu (V. Novack).

0735-6757/$ – see front matter © 2008 Elsevier Inc. All rights reserved.
doi:10.1016/j.ajem.2007.10.016

hypothermia [4]. Most of these deaths occurred in men, particularly in the elderly population [3,4]. Not surprisingly, a higher proportion of hypothermia-related deaths have been reported during the winter in geographic areas with particularly severe weather conditions such as Alaska and Montana [3,4]. Notwithstanding, hypothermia has also been consistently reported in other states and countries with warmer climates [5-7].

Few epidemiological studies have been published in the literature examining the risk factors and comorbidities associated with hypothermia-related mortality [8]. No data are available examining the incidence of hypothermia in geographical regions with a warm climate. This study was conducted in the Negev desert area of Israel, a mostly arid zone except for its northern part with its semiarid climate [9].

The aim of the present study was to determine the frequency and main features of hypothermia in the population of southern Israel. We hypothesized that hypothermia is a not a rare clinical entity even in an area with mild climate. We retrospectively evaluated the different demographic, clinical, and prognostic factors related to hypothermia aiming to derive a prediction score for inhospital mortality. The study recorded the real-time meteorological conditions for the occurrence of hypothermia during this period.

2. Methods and definitions

We conducted a retrospective study at Soroka University Medical Center, a 1200-bed tertiary care teaching medical center located in Beer Sheva, which serves as the only regional hospital for Southern Israel (estimated population of 700 000). The city of Beer Sheva is situated at 275 m above sea level. The climate in the area is of semiarid type [9]. January is the coldest month, with temperatures from 5°C to 10°C, and August is the hottest month at 18°C to 38°C. The average rain fall is 260 mm a year. Weather conditions on the day before and on the day of admission were assessed [10]. Mean day high and low temperatures and precipitation were recorded.

2.1. Patient selection

All admissions to the hospital over a 6-year period (January 2000 to December 2005) of patients older than 18 years were screened by assessing computerized *International Classification of Diseases, Ninth Revision* (*ICD-9*)–coded diagnoses. All individual patients' charts with a diagnosis of hypothermia were retrieved (*ICD-9* codes: 991.6, 778.3, 995.89, 780.99, and 780.9). One of the authors (EG) reviewed all the files with aforementioned *ICD-9* codes and all patients who presented to the emergency department (ED) with rectal temperature lower than 35°C and either admitted to the hospital or died in ED were enrolled into the study. Hypothermia was defined as mild if rectal temperature on admission was between 32.3° and 35°C; moderate, 28° to 32.2°C; and severe, less than 28°C. We define the hypothermia as "exposure-related" if the patient was found outdoors on a day during which the minimal temperature was less than 20°C and did not have a diagnosis of sepsis on admission.

Demographic data, background disease, presenting symptoms, laboratory tests results, and medication used before hospitalization were obtained from the patient's charts.

The major condition which was associated with the hypothermia was identified as a primary diagnosis leading to the admission (as appeared in the patient discharge chart). In addition, we defined severe sepsis diagnoses based on the chart review (VN). The criteria for severe sepsis were those established by the PROWESS investigators [11]. In all cases in which the patient presented with an infection or one of the sepsis syndromes, this was defined as the main condition regardless of other diagnosed disorders.

The study was approved by the local institutional review board.

2.2. Statistical analysis

Continuous variables were expressed as mean ± SD. Median values as well as interquartile range (IQR) are presented for abnormally distributed continuous variables. Normality of the study variables was tested with a 1-sample Kolmogorov-Smirnov test to indicate the appropriateness of parametric testing. The unpaired Student *t* test was performed for comparative analysis of normally distributed variables, and the Mann-Whitney *U* test was used for nonparametric analysis. Similarly, for comparison of more than 2 groups, analysis of variance and Kruskall-Wallis test were used. Correlations between continuous variables were assessed by the Pearson test. Categorical variables were expressed as percentage and comparisons between groups were made using the χ^2 test.

We used a logistic regression model to identification predictors of inhospital mortality. Factors found by the univariate analysis to be associated with the 30-day mortality with $P < .10$ were included into the model. To develop a practical prognostic score, we assigned the risk factors identified by the multivariable analysis weighted points proportional to the odds ratio values (rounded to the nearest integer). A risk score was then calculated for each patient. The predictive accuracy of the scoring system was examined by evaluating ROC curves. 95% Confidence interval (CI) for area under the curve was defined using nonparametric bootstrapping, drawing 1000 samples with replacement of the same size as the original samples of patients. Results were considered significant at $P < .05$.

3. Results

During 6 years of the study 169 patients with hypothermia were admitted to the hospital. Thus, the annual rate of hypothermia identified at the hospital admission was 7.8 per 100 000 adult population. This rate varied between different age groups with the lowest being between 18 and 24 years (2.5 per 100 000), and the highest, in the group older than 75 years (65.9 per 100 000). Hypothermia was defined as mild in 120 (71.0%), moderate in 40 (23.7%) and severe in 9 (5.3%) of the cases. The major medical conditions associated with a decreased body temperature were identified as follows: sepsis, 65 (38.5%); trauma, 34 (20.1%); endocrine disorders (hypothyroidism, hypoadrenalism, and hyperglycemia), 19 (11.2%); drugs or narcotics overdose and alcohol, 15 (8.9%); stroke, 10 (5.9%); nontraumatic bleeding (gastrointestinal or internal), 7 (4.1%); and other (aborted sudden death, end-stage cancer, etc), 19 (11.2%). Of 169 patients, 47 (27.8%) were found outdoors by the paramedics. Exposure-related hypothermia was identified in 42 patients (24.9%).

Table 1 describes patients' background diseases and demographic and living conditions. Of 9 patients with severe hypothermia, 6 (66.7%) were living in unattended settings (homeless or no close family), compared with 12 (30%) with moderate and 15 (12.5%) with mild hypothermia ($P < .001$). There were no differences between groups with different degrees of hypothermia in prevalence of background diseases (data not shown). Of 65 patients diagnosed with sepsis, 18 (27.7%) had pneumonia; 23 (35.4%), urinary tract infection; 2 (3.1), soft tissue infection; and 22 (33.9), other sources of infection (biliary tract, gastrointestinal tract, central nervous system, bone, and unknown source). Patients with sepsis were older (74.4 ± 16.2 years vs 54.7 ± 22.8 years, $P < .001$) as compared with the rest of the cohort. Moreover, septic patients had higher burden of chronic disease: diabetes, 40.0% vs 23.1%, $P = .02$; atherosclerotic disease, 49.2% vs 31.7%, $P = .02$; and chronic renal failure, 33.8 vs 19.2%, $P = .03$.

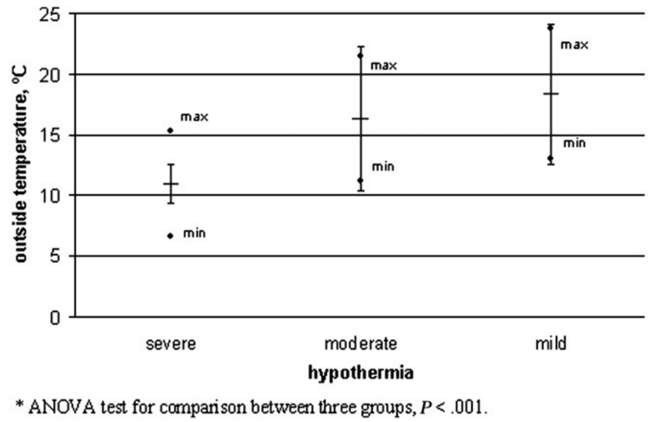

Fig. 1 Mean environmental temperature (day before and at admission) in patients with different degree of hypothermia. Mean minimal and maximal temperature and 95% CI of the mean are presented. Asterisk indicates analysis of variance for comparison between the 3 groups ($P < .001$).

As may be expected, most admissions were in the winter months (December to February, 65 [38.5%] cases), but 27 (16.0%) of the patients were admitted during the summer (June to August). Fig. 1 depicts temperature conditions on the day before as well as the actual day of admission. The median environmental temperature on these 2 days was 15.4°C, with an IQR of 12.6°C to 23.4°C. The mean 2-day high temperature was 15.3°C in the severe hypothermia group, 21.4°C in the moderate group and 29.3°C in the mild group. The mean 2-day low temperature in the 3 groups was 6.6°C, 11.2°C, and 13.0°C, respectively. There was a significant correlation between mean environmental temperature on the 2 recorded days and the rectal temperature upon the admission ($r = 0.29$, $P < .001$). Overall, in 46 cases (27.2%), there was a rain on the day before or on the day of admission. Rain was recorded in 6 (66.7%) of 9 of severe; 14 of 40, moderate; and 26 (21.7%) of 120, mild hypothermia admissions.

Table 2 describes clinical, laboratory, and hospitalization characteristics of the study population. Lower rectal temperature at admission was associated with lower blood pressure—mean arterial pressure (MAP) of 84 ± 24, 74 ± 32, and 66 ± 31 mm Hg in mild, moderate, and severe hypothermia, respectively ($P = .03$). Severely hypothermic patients tended to have higher rates of renal insufficiency (creatinine >1.5 mg/dL) than the moderate or mild hypothermic patients (66.7%, 50.0%, and 35.0%, respectively, $P = .06$).

Table 3 compares the group of 42 patients with exposure related hypothermia to the rest of the cohort. Of these, 36 (85.7%) were admitted with either trauma or drug or alcohol

Table 1 Demographic and background illnesses characteristics of the patients' population

	All patients (n = 169)
Age (y)	62.3 ± 22.6
Male sex (%)	103 (60.9)
Type of residence (%)	
With family	92 (54.4)
Nursing home	44 (26.0)
Alone	24 (14.2)
Homeless	9 (5.3)
Found outdoors (%)	47 (27.8)
Background illness	
CIHD (%)	45 (26.6)
CHF (%)	29 (17.2)
Diabetes (%)	50 (29.6)
Stroke (%)	17 (10.1)
PVD (%)	25 (14.8)
Dementia (%)	18 (10.7)
Chronic renal failure (%)	42 (24.9)
Hypothyroidism (%)	15 (8.9)
Malignancy (%)	15 (8.9)
Psychiatric diseases (%) [a]	23 (13.6)
Alcohol abuse (%)	22 (13.0)

CIHD indicates chronic ischemic heart disease; CHF, congestive heart failure; PVD, peripheral vascular disease.
[a] Schizophrenia or major mood disorder.

Table 2 Clinical, laboratory, and hospitalization characteristics of the patients upon the admission stratified by the hypothermia severity

	All patients	Hypothermia (rectal temperature)			*P*
	n = 169	Severe (<28°C) (n = 9)	Moderate (28°-32.2°C) (n = 40)	Mild (32.3°- 35°C) (n = 120)	
Systolic blood pressure (mm Hg)	116 ± 39	98 ± 44	109 ± 48	119 ± 35	.13
Diastolic blood pressure (mm Hg)	63 ± 23	50 ± 25	56 ± 26	66 ± 20	.01
MAP (mm Hg)	81 ± 27	66 ± 31	74 ± 32	84 ± 24	.03
Confusion (%)	111 (65.7)	6 (66.7)	32 (80.0)	73 (60.8)	.09
Pulse (min^{-1})	80 ± 27	67 ± 25	75 ± 30	83 ± 26	.08
Oxygen saturation (%)	91 ± 8	88 ± 12	89 ± 9	92 ± 7	.08
Laboratory data					
pH (median and IQR)	7.30 (7.10-7.40)	7.23 (7.10-7.38)	7.30 (7.10-7.36)	7.30 (7.10-7.40)	.78 [a]
Urea (mg/dL)	78 ± 68	168 ± 138	82 ± 67	70 ± 56	.001
Creatinine (mg/dL) (median and IQR)	1.2 (0.8-2.2)	3.6 (1.0-5.3)	1.6 (0.9-2.3)	1.1 (0.8-2.0)	.11 [a]
Na (mEq/L)	138 ± 8	141 ± 8	139 ± 6	137 ± 8	.23
K (mEq/L)	4.6 ± 1.1	5.2 ± 1.5	4.5 ± 1.2	4.6 ± 1.1	.23
Glucose (mg/dL)	151 ± 103	140 ± 79	131 ± 89	158 ± 109	.37
Albumin (g/dL)	2.9 ± 0.7	2.9 ± 1.0	3.0 ± 0.5	2.9 ± 0.8	.87
CPK (U/L) (median and IQR)	179 (64-607)	255 (80-5167)	322 (93-577)	149 (63-540)	.26 [a]
WBC (10^{-3}) (median and IQR)	12.0 (7.9-16.7)	9.3 (6.7-15.5)	12.0 (7.5-16.0)	11.6 (8.0-17.0)	.68 [a]
Platelets (10^{-3})	221 ± 123	224 ± 126	200 ± 156	228 ± 110	.49
INR (median and IQR)	1.2 (1.0-1.8)	1.0 (1.0-1.3)	1.4 (1.0-2.2)	1.2 (1.0-1.8)	.14 [a]
ECG analysis					
Elevated J-point (%)	45 (26.6)	6 (66.7)	17 (42.5)	22 (18.3)	<.001
Corrected QT interval (milliseconds)	44.3 ± 4.3	48.0 ± 5.3	44.8 ± 3.6	43.9 ± 4.3	.04
PR interval (milliseconds)	18.2 ± 6.0	18.7 ± 8.4	17.5 ± 5.6	18.3 ± 6.0	.95
Rhythm disturbance (%)	43 (25.4)	4 (44.4)	13 (32.5)	26 (21.7)	.16
Time to rewarming (35°C) (h)	2 (1-5)	6.0 (4.5-8.5)	4.5 (2.0-7.8)	2 (1-3)	.001 [a]
Mechanical ventilation (%)	96 (56.8)	6 (66.7)	26 (65.0)	64 (53.3)	.36
ICU admission (%)	62 (36.7)	5 (55.6)	16 (40.0)	41 (34.2)	.39
Total length of stay (d) (median and IQR)	4 (2-9)	6 (3-23)	2 (2-9)	4 (2-9)	.05 [a]
Inhospital mortality (%)	80 (47.3)	6 (66.7)	21 (52.5)	53 (44.2)	.32

WBC indicates white blood cells; INR, international normalized ratio; ECG, electrocardiogram; ICU, intensive care unit; CPK, creatine phosphokinase.
[a] Kruskal-Wallis test.

overdose. Patients with exposure-induced hypothermia were younger and had lower burden of the chronic diseases.

The inhospital mortality rate in our cohort was 47.3% (95% CI, 39.8%-54.7%). To identify independent factors for mortality prediction, logistic regression models were built (Table 4). Variables significantly associated with inhospital death in univariate analysis ($P < .10$) were dichotomized (normal vs abnormal value) and included in the analysis. Odds ratios of the variables which remained in the final model were linearly transformed into the risk score, which was calculated for each patient. The final score included 5 variables assessed on admission: age above 70 years (1 point), MAP below 90 mm Hg (1 point), pH below 7.35 (1 point), creatinine above 1.5 mg/dL (1 point), and confusion upon ED admission (3 points, having the highest odds ratio). The severity of hypothermia—either divided into 3 groups or as a continuous variable—was not a significant predictor of inhospital mortality.

Median total score was 4, with IQ range of 3 to 6. Score results were divided in to 3 risk groups: 64 patients (37.9%) had low score (0-3); 58 (34.3%), intermediate (4-5); and 47 (27.8%), high score (6-7). In the low-risk group, the inhospital mortality rate was 20.3% (13/64); in the intermediate-risk group, 50.0% (29/58); and in the high-risk group, 80.9% (38/47) ($P < .001$). In the group of 11 patients with a score of 7 (maximal possible), the mortality rate was 100%. The ROC curves used for sensitivity analysis (Fig. 2) showed that the proposed score had an area under the curve of 0.81 (95% CI, 0.75-0.87, 1000 bootstrap samples).

Discussion

Hypothermia is a condition encountered not infrequently in the ED [12]. Traditionally, hypothermia has been related to a breakdown of the normal mechanisms of thermoregulation as a consequence of exposure to overwhelming cold [4,8,12,13]. The actual worldwide number of "outdoor" patients presenting with hypothermia is unclear. Poverty,

Table 3 Comparison of the group of patients with exposure related hypothermia with the rest of the cohort

	Rest of the cohort	Exposure related	*P*
	n = 127	n = 42	
Age (y)	70.3 ± 18.8	38.1 ± 14.6	<.001
Male sex (%)	70 (55.1)	33 (78.6)	.01
Background diseases			
Diabetes (%)	47 (37.0)	3 (7.1)	<.001
Atherosclerotic disease (%)[a]	61 (48.0)	4 (9.5)	<.001
Chronic renal failure (%)	41 (32.3)	1 (2.4)	<.001
Malignancy (%)	15 (11.8)	-	.02
In hospital			
Rectal temperature at admission (°C)	33.2 ± 1.9	32.7 ± 2.1	.12
Hypothermia class			
Mild (32.3°C-35°C)	95 (74.8)	25 (59.5)	.11
Moderate (28°C-32.2°C)	25 (19.7)	15 (35.7)	
Severe (<28°C)	7 (5.5)	2 (4.8)	
Time to rewarming (35°C) (h) (median and IQR)	2 (1-4)	3 (1-6)	.04
Mechanical ventilation (%)	65 (51.2)	31 (73.8)	.01
ICU admission (%)	36 (28.3)	26 (61.9)	<.001
Inhospital mortality (%)	65 (51.2)	15 (35.7)	.08

Mann-Whitney *U* test.

[a] Atherosclerotic disease is defined as history of chronic ischemic heart disease, peripheral vascular disease, or stroke.

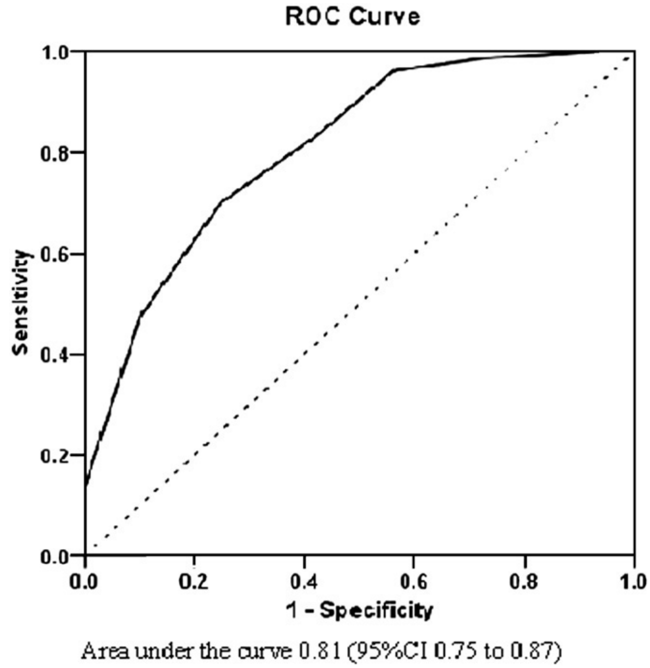

Fig. 2 Receiver operating characteristic curve for logistic regression model derived inhospital mortality prediction score.

homelessness, and alcoholism are frequently associated conditions [3,4,12]. The mortality of these patients with moderate or severe accidental hypothermia remains high despite supportive care [14].

Hypothermia also occurs in patients with an impairment of the thermoregulatory mechanism unrelated to exposure to a cold environment [6,12,15]. Common underlying disorders can lead to this predominantly "indoor" or inpatient-related hypothermia. Among the common causes for this are sepsis; hypothyroidism; hypopituitarism; trauma; stroke; and renal, heart, and liver failure as well as ethanol or drug intoxication [16-18]. In patients with sepsis and heart failure, hypothermia has been found to be a strong predictor of mortality in multivariate analysis [17-20]. In fact, hypothermia occurring indoors is linked with worse outcomes than the conventional outdoor or exposure hypothermia [17].

Our study represents the experience of a large tertiary center located in a desert area treating hypothermic patients over a period of 5 years. We hypothesized that hypothermia is not uncommon to the regions with a desert climate type. After reviewing the complete national temperature records from the meteorological service in relation with the incidence of hypothermia during the study period, it became clear that the risk of hypothermia was present even during the warmest months of the year. It was more frequent during the winter, but again, the lowest measured outside temperature was above 6°C during this season—far from that reported in northern countries. Less than 30% of the hypothermic cases were found to be related to outdoor exposure (similar to a

Table 4 Univariate analysis and logistic regression models for in-hospital mortality prediction score derivation based upon admission characteristics.

	Univariate analysis			Logistic regression model	
	Survivors (n = 89)	Decedents (n = 80)	Relative risk of death (95% CI)	Odds ratio (95% CI)	Risk score
Age ≥70 (y) (%)	35 (39.3)	45 (56.3)	1.4 (1.0-2.0)	2.5 (1.1-5.4)	1
Mean arterial pressure <90 mm Hg (%)	45 (50.6)	58 (72.5)	1.4 (1.1-1.8)	2.6 (1.2-5.6)	1
pH <7.35 (%)	37 (41.6)	54 (67.5)	1.6 (1.2-2.2)	2.4 (1.1-5.0)	1
Creatinine >1.5 mg/dL (%)	24 (27.0)	44 (55.0)	2.0 (1.4-3.0)	3.1 (1.4-6.9)	1
Confusion upon admission (%)	42 (47.2)	69 (86.3)	1.8 (1.4-2.3)	6.8 (2.9-16.0)	3

Assignment of points to risk factors was based on a linear transformation of the corresponding odds ratio. The odds ratio for each variable was divided by 2.37 (the lowest value, corresponding to pH <7.35) and rounded to the nearest integer.

reported frequency of outdoor-associated hypothermia in Scotland) [7], which highlighted the importance of indoor hypothermia in our cohort. The contribution of outdoor temperature to hypothermic state was more prominent in cases of severe hypothermia, as most of these cases (66%) were encountered in individuals living in unattended settings.

Most patients in our study had a major medical condition contributing to the presence and severity of hypothermia. Only the least of cases represented the "classic" scenario of hypothermia secondary to extremely low outdoor temperatures in an otherwise healthy subject. This would suggest that in hypothermic patients presenting to the ED an emphasis should be made on seeking an underlying treatable medical condition such as sepsis, endocrine emergencies and drug overdose rather then merely treating the symptom.

We found that the inhospital mortality rate associated with hypothermia was considerable (47.3% in our cohort). Surprisingly, in contradiction with other reports in the literature, the severity of hypothermia in the current study was not a significant predictor of mortality [16-20]. This lack of statistically significant difference in mortality rate between subgroups of patients according to a hypothermia grade could be explained by an insufficient power of our investigation to detect subtle differences among the subgroups. Nevertheless, we have been able to predict a worse outcome through a simple score, developed up based on 5 variables (age, mean arterial pressure, confusion, pH, and creatinine level) available on presentation to the ED.

To the best of our knowledge, this is the first study offering a tool to predict mortality in patients with hypothermia. If further validated, this tool could guide decision making concerning mode of treatment such as early administration of fluids, vasopressors, and antibiotics when relevant and choosing the appropriate site of care (general medical ward vs intensive care unit).

This retrospective study has several limitations. First, it presents the experience of a single medical center with its unique ethnic blend. Thus, conclusions should be interpreted cautiously when applied to other settings. Second, hypothermia was defined and monitored based on rectal temperature measurement, a method that tends to lag after other core sites during rewarming [13]. It is unclear from the present analysis if the observed physiological perturbations that correlated with the severity of hypothermia were an expression of the medical conditions accompanying hypothermia or a consequence to the low core body temperature itself and its duration. In addition, we were unable to ascertain the duration of the exposure to low temperature before presentation to the ED. Finally, the results of our multivariable analysis and the severity score constructed were not prospectively validated and should be further validated in such a trial.

In summary, this report highlights 3 important aspects: first, hypothermia is not a unique clinical entity confined to cold countries, as it may be encountered even in areas of semiarid and arid climate; secondly, hypothermia is frequently associated with underlying serious medical conditions, involving mainly the elderly population; finally, it may be possible to establish an appropriate hospital strategy based upon a simple clinical score, aiming to improve adverse outcomes in high risk hypothermia patients.

References

[1] Aslam AF, Aslam AK, Vasavada BC, Khan IA. Hypothermia: evaluation, electrocardiographic manifestations, and management. Am J Med 2006;119(4):297-301.

[2] Ben-Noun LL. Was the biblical King David affected by hypothermia? J Gerontol A Biol Sci Med Sci Jun 2002;57(6):M364-7.

[3] Fallico E, Nolte K, Siciliano L, Yip F. Hypothermia-related deaths—United States, 2003-2004. MMWR Morb Mortal Wkly Rep 2005;54 (7):173-5.

[4] Murphy T, Zumwalt R, Fallico F. Hypothermia-related deaths—United States, 1999-2002 and 2005. MMWR Morb Mortal Wkly Rep 2006;55(10):282-4.

[5] MacDonell JE, Wrenn K. Hypothermia in the summer. South Med J 1991;84(6):804-5.

[6] Muszkat M, Durst RM, Ben-Yehuda A. Factors associated with mortality among elderly patients with hypothermia. Am J Med 2002;113(3):234-7.

[7] Hislop LJ, Wyatt JP, McNaughton GW, et al. Urban hypothermia in the west of Scotland. West of Scotland Accident and Emergency Trainees Research Group. BMJ 1995;311(7007):725.

[8] Herity B, Daly L, Bourke GJ, Horgan JM. Hypothermia and mortality and morbidity. An epidemiological analysis. J Epidemiol Community Health 1991;45(1):19-23.

[9] Israel Ministry of Foreign Affairs. The land: geography and climate. http://www.israel.org/MFA/Facts+About+Israel/Land/THE+LAND+Geography+and+Climate.htm. Accessed 28.03.2007.

[10] Historical weather conditions at Beer-Sheva. TuTiempo.net. http://www.tutiempo.net/en/Climate/Beer-Sheva/401910.htm. Accessed 20.08.2006.

[11] Bernard GR, Vincent JL, Laterre PF, et al. Efficacy and safety of recombinant human activated protein C for severe sepsis. N Engl J Med 2001;344(10):699-709.

[12] Danzl DF, Pozos RS, Auerbach PS, et al. Multicenter hypothermia survey. Ann Emerg Med 1987;16(9):1042-55.

[13] Kempainen RR, Brunette DD. The evaluation and management of accidental hypothermia. Respir Care 2004;49(2):192-205.

[14] Vassal T, Benoit-Gonin B, Carrat F, Guidet B, Maury E, Offenstadt G. Severe accidental hypothermia treated in an ICU: prognosis and outcome. Chest 2001;120(6):1998-2003.

[15] Taylor AJ, McGwin Jr G. Temperature-related deaths in Alabama. South Med J 2000;93(8):787-92.

[16] Delaney KA, Vassallo SU, Larkin GL, Goldfrank LR. Rewarming rates in urban patients with hypothermia: prediction of underlying infection. Acad Emerg Med 2006;13(9):913-21.

[17] Megarbane B, Axler O, Chary I, Pompier R, Brivet FG. Hypothermia with indoor occurrence is associated with a worse outcome. Intensive Care Med 2000;26(12):1843-9.

[18] Peres Bota D, Lopes Ferreira F, Melot C, Vincent JL. Body temperature alterations in the critically ill. Intensive Care Med 2004;30(5):811-6.

[19] Casscells W, Vasseghi MF, Siadaty MS, et al. Hypothermia is a bedside predictor of imminent death in patients with congestive heart failure. Am Heart J 2005;149(5):927-33.

[20] Payvar S, Orlandi C, Stough WG, et al. Comparison of 60-day mortality in hospitalized heart failure patients with versus without hypothermia. Am J Cardiol 2006;98(11):1485-8.