Original Article

A STUDY OF ACCIDENTAL HYPOTHERMIA IN INSTITUTIONALIZED ELDERLY

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Study conducted at Hospital Geriátrico e de Convalescentes D. Pedro II, Irmandade da Santa Casa de Misericórdia de São Paulo, São Paulo, SP, Brazil.

ABSTRACT

Objective. To analyze the prevalence, causes and outcome of hypothermia in institutionalized elderly.

Methods. Prospective study held from January to December, 2004 at Hospital Geriátrico e de Convalescentes Dom Pedro II, with 483 long-term care patients. Hypothermia was diagnosed by esophageal thermometer in all patients with axillary temperature below or equal to 35°C (95°F). Both etiologic diagnosis and complications from hypothermia were noted in clinical and subsidiary examinations. Tests included: ECG, chest radiography, blood count, blood gas analysis, glycemia, metabolites, biochemical blood tests, amylase, kidney and liver functions, urinalysis and serology for HIV, syphilis and hepatitis B. Rewarming was adopted, among other actions in the treatment protocol.

Results. Prevalence of hypothermia was 7.2 percent, and the condition was found most often in women (65.7%). The mean age in the sample was 76.4 years. Most patients (77.1%) had high degrees of dependence (Katz index "F" and "G"). Mild hypothermia was identified for most (71.4%) patients. The mortality rate was 62.8 percent, 31.4 percent during hypothermia and 31.4 percent after reversal. Infections were the etiology in all cases: pneumonia (80.0%), urinary tract infection (60.0%), and pressure ulcer (17.1%). There was more than one infection for the same patient in 60 percent of cases.

Conclusion. Hypothermia in institutionalized elderly is a serious clinical condition with high rates of mortality. Prevention, early diagnosis and measures of core rewarming improve prognosis.

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Introduction

The core body temperature of human beings (heart, lungs, brain and splanchnic organs) ranges from 36.6°C to 37.6° C, and maintaining is key for maintaining homeostasis.[1] Despite the development of techniques for adapting to very low temperatures, cold-related mortality is still significantly higher during winter months, especially in cold climate regions.[2]

Environmental exposure to low temperatures is an important inducer of hypothermia, but secondary causes, such as congenital diseases (Shapiro syndrome), vasodilators, and nutritional disorders also contribute to its onset.[3]

Clinical hypothermia is defined as decreases in core temperature to 35°C or less, a medical emergency requiring procedures to reestablish thermostasis, since various systems may suffer severe alterations. These range from pancreatitis[4] and coronary ischemia[5] to circulatory collapse, eventually resulting in death.[6]

Special populations, such as the elderly, infants, the homeless, alcoholics and patients suffering from chronic illnesses, require permanent surveillance due to their fragility and their being at risk for hypothermia.[7, 8]

Knowledge of hypothermia in elderly patients is based on experience with clinical cases and prospective studies with younger patients.[9] Specific studies about elderly patients suffering from hypothermia, especially those in long-term care facilities (LTCF) are rare; the literature reviewed in this study mentions only that the elderly are at high risk for hypothermia, requiring further studies and special attention for the age group.[8,10]

The objectives of this study were to (a) identify the prevalence of accidental hypothermia among the elderly population in a long-term care facility; (b) assess comorbidities and causes of hypothermia; (c) assess the mortality rate from accidental hypothermia in that population; and (d) compare clinical and laboratory data from patients with favorable outcomes to those from patients who died during hypothermia and after reversal.

According to data from the literature reviewed, the initial hypotheses for this group would involve finding high rates of incidence and mortality, multiple comorbidities, and more critical laboratory profiles among patients who died during an episode of hypothermia

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Methods

This prospective study was held from January to December, 2004 at Hospital Geriátrico e de Convalescentes Dom Pedro II (HGCDP II), with all of its 483 long-term care patients. This LTCF comprehends 23 admission units, with capacity ranging from 13 to 42 beds, and whose residents are divided according to degree of dependence. The Acute Care Unit consists of a 29-bed ward, four of which are semi-intensive beds and one an isolation bed. It hosts both institutionalized residents suffering from an urgent medical condition and outside patients from other public hospitals.

The protocol was developed after approval from the Research Ethics Committee of Irmandade da Santa Casa de Misericórdia de São Paulo (ISCMSP), under protocol number 129/03.

The institution's entire nursing staff received training and guidance regarding the reasons behind the study and the importance of identification and early diagnosis of accidental hypothermia. An active search began, consisting of thrice daily assessment of axillary temperature of all patients (morning, afternoon, night), using prismatic clinical thermometers with mercury stems, with scales from 35°C to 42°C, divided in 0.1°C intervals, manufactured by Incoterm (Brazilian Ministry of Health registry number 10343200005).

All patients with axillary temperature $\leq$35°C were selected for measurement of core temperature, monitored solely through esophageal temperature. We used a TTE-II telethermometer manufactured by Digicare Tecnologia Biomédica Ltda., serial number 0308, with a DGP-20 esophageal temperature sensor of the same brand, serial number 0483, with scales from -20 to 50°C, and precision of 0.1°C between 34°C and 42°C and 0.3 degrees between 15°C and 45°C. The temperature was measured using the technique of nasogastric insertion of the temperature sensor, placed on the junction of the distal and middle thirds of the esophagus.[11] Three minutes of waiting were required before stabilization for accurate reading of core temperature.

All patients identified as suffering from hypothermia (esophageal temperature $\leq$35°C) were referred to the Acute Care Unit for treatment. Those 60 years old or older were selected for the study protocol. The sample consisted of 35 episodes of hypothermia in 31 patients during one year.

Both the etiologic diagnosis and the complications secondary to hypothermia were diagnosed by clinical and subsidiary emergency examinations. Tests included: ECG, chest radiography, urinalysis, blood count, blood gas analysis, glycemia, sodium, potassium, calcium, magnesium, urea, creatinine, amylase, creatine phosphokinase, MB fraction of creatine phosphokinase, total protein, albumin, prothrombin time, activated partial thromboplastin time, syphilis serum reaction (SSR), hepatitis B serology (HBsAg), and anti-HIV I and II.

In terms of severity, hypothermia was classified as mild (>32°C to 35°C), moderate (from 28°C to 31.9°C), and severe (<28°C)[12], enabling us to define the appropriate course of treatment: passive external (for temperatures between 35°C and 32°C), active external (31.9°C to 28°C) or active internal (<28°C) rewarming. Esophageal temperature was measured every two hours, and treatment was only suspended after core temperature reached values above 35°C, later monitored every six hours.

Core rewarming for reversal of hypothermia included adding blankets; appropriate clothing; warm diet; placement of thermal bag on anterior thorax or rotation with "serum belt" heated to 42°C and changed every 30 minutes; inhalation of warm air; and infusion of saline 0.9% heated to 42°C with equipment in serpentine system heated to same temperature. Other therapeutic measures included infusion of hypertonic glucose 50% (G-50%), when necessary; correction of occasional acidosis after warming; and prescription of antibiotic therapy, if necessary.

The data were duly collected and tabled for an initial descriptive analysis. Data expressed in terms of mean averages and standard deviations were analyzed and compared by using Student's *t* test. Data expressed as percentage and/or absolute frequencies were analyzed and compared through the chi-square or Fisher's exact tests, depending the distribution of dependent and independent variables. A probability of 95% ($p \leq 0,05$) was established to determine what differences between variables were significant.

Results

During the one-year period, there were 35 episodes (in 31 patients) of accidental hypothermia at HGCDPII, which had 483 residents at the time of this study, thus giving an annual rate of prevalence of 7.2 percent for accidental hypothermia. Data describing these patients and levels of hypothermia by gender can be found in Table 1.

Mean core temperature was 32.7±1.8°C, with no comparative difference between men and women ($p = 0.3687$). The lowest core temperature found was 25°C, in an 86 years old woman under investigation for chronic anemia, with the presence of extensive bronchopneumonia (BCP) seen in chest radiography.

The most frequent comorbidities (see Table 2) recorded included systemic hypertension (91.4%); dementia syndrome (71.4%); immobility (68.6%); pressure ulcer (68.2%); history of strokes in 57.2% (significantly more frequent among men), and diabetes mellitus in 42.6% (significantly more frequent among women). No patient had only one comorbidity. Most (57.2%) had four associated comorbidities; seven others (20.0%) had three; six elderly patients (17.1%) had five or more. Only two patients (5.7%) had just two associated conditions.

The immediate cause of the 35 episodes of hypothermia in elderly patients at HGCDP II were secondary to some form of infection. Among the infections found in this sample, the most frequent were bronchopneumonia (80.0%) and urinary tract infection (60.0%). Infected pressure ulcers were found in 17.1 percent of cases. Only male patients suffered gangrenes (2.8%), while only one case of osteomyelitis (2.8%) and one of peritonitis (2.8%) were found, both in women. For 40.0 percent of patients, there was a single infection; for 48.6 percent, two infections; and for 11.4 percent, three infections.

All results from laboratory tests were similar for men and women. For the group as a whole, tests showed alterations in hemoglobin, hematocrits, leukocytes, prothrombin time, calcium, urea, creatinine, glycemia, MB fraction of creatine phosphokinase, total protein, and albumin; relevant for disease physiopathology. Complete laboratory findings can be found in Table 3.

In terms of outcomes, 97.1 percent of patients went into septic shock, while 22.8 percent suffered from respiratory failure.

Table 1 - Characteristics of patients who suffered the 35 episodes of hypothermia at Hospital Geriátrico e de Convalescentes D. Pedro II during the year 2004

Characteristics	Distributions		
Gender (n / %)	Female	23 / 65.7%	
	Male	12 / 32.3%	p = 0.0628^
Race (n / %)	White	25 / 71.4%	
	Nonwhite	10 / 28.6%	p = 0.0112^
Ages (mean+standard deviation)	Women	79.6+10.6	
	Men	70.3+6.6	
	General group	76.4+10.6	p = 0.0098l
Degrees of hypothermia (n / %)			
Mild	Women	19 / 82.6%	
	Men	6 / 50.0%	
	General group	25 / 71.4%	
Moderate	Women	3 / 13.0%	
	Men	6 / 50.0%	
	General group	9 / 27.0%	
Severe	Women	1 / 4.4%	
	Men	0 / -	
	General group	1 / 1.6%	p = 0.0375^

(^) Yates' chi-square test; (l) Student's T test.

Table 2 - Percentage distribution of the 35 episodes of hypothermia in 31 institutionalized patients, by gender in relation to comorbidities.

Comorbidities	Women	Men	Total	p
Stroke	43.5%	90.1%	57.2%	p = 0.0087
DM	60.9%	9.1%	42.6%	p = 0.0087
COPD	13.0%	9.1%	11.4%	p = 0.9219
Alcoholism	4.3%	16.7%	8.6%	p = 0.3333
Hypertension	91.3%	91.7%	91.4%	p = 0.5013
Hepatopathy	4.3%	0	2.8%	p = 0.8990
Hypothyroidism	8.7%	0	5.7%	p = 0.7530
CHF	30.4%	8.3%	22.8%	p = 0.2918
Immobility	65.2%	75.0%	68.6%	p = 0.8864
CRF	8.7%	8.3%	8.6%	p = 0.9596
Dementia syndrome	69.5%	75.0%	71.4%	P=0.9559
Smoking	8.9%	33.3%	17.1%	p = 0.1213
Pressure ulcer	69.6%	66.7%	68.2%	p = 0.9023

Stroke (acute cerebrovascular attack); DM (Diabetes mellitus); COPD (chronic obstructive pulmonary disease); Hypertension (systemic hypertension); CHF (congestive heart failure); CRF (chronic renal failure).

Table 3 - Mean averages and standard deviation of results from laboratory tests, distributed by outcome of the 35 episodes of hypothermia in 31 institutionalized patients, by gender.

Laboratory tests	Women		Men		Total	p
	Results	References	Results	References		
pH	7.3+0.15	7.34-7.45	7.4+0.11	7.34-7.45	7.3+0.14	0.3981
PCO2	41.7+9.2	35-45	35.3+23.9	35-45	39.4+19.9	0.2841
PO2	102.3+47.3	80-100	85.4+41.1	80-100	96.2+45.3	0.3090
Base excess	-5.61+6.8	-3-+3	-3.1+7.9	-3-+3	-4.7+7.2	0.3424
HCO3	19.8+6.8	22-26	20.8+7.2	22-26	20.1+6.8	0.6979
SAT O2	92.1+11.9	95-99	92.6+5.5	95-99	92.3+9.9	0.8539
Hb	9.0+2.7	11.7-15.7 g/dL	9.7+2.6	13.3-17.7 g/dL	9.3+2.6	0.4724
Ht	28.5+7.8	35-47 mL/dL	29.9+7.4	40-52 mL/dL	29.0+7.6	0.6040
Leukocytes	14.370+9.677	5,000-10,000/mm3	13,625+7,811	5,000-10,000/mm3	14,090+8,898	0.8229
Segmented	73.4+16.5	1,800-7,000/mm3	79.2+7.5	1,800-7,000/mm3	75.6+13.9	0.1817
Rods	3.5+5.0	0-1,000/mm3	4.6+6.3	0-1,000/mm3	3.9+5.5	0.5254
Lymphocytes	19.9+17.1	1,000-5,000/mm3	12.5+7.2	1,000-5,000/mm3	17.2+14.5	0.1635
Monocytes	1.8+1.3	80-1,200/mm3	1.9+1.9	80-1,200/mm3	1.8+1.5	0.8358
Basophils	0	0-200/mm3	0.7+1.4	0-200/mm3	0.3+0.9	0.1359
Eosinophils	1.2+2.2	0-600/mm3	0.8+1.7	0-600/mm3	1.1+2.0	0.5838
Meta-segmented	0.2+0.7	0	0.1+0.3	0	0.2+0.6	05862
Platelets	260,650+ 192.284	140,000-400,000/mm3	161,1666+ 72,654	140,000-400,000/mm3	223,343+ 164,090	0.0973
PT	14.7+3.5	11.0-13.5 s	14.4+2.9	11.0-13.5 s	14.6+3.3	0.7686
Prothrombin activity	64.0+21.8	70-100%	67.5+28.5	70-100%	65.3+24.2	0.7048
INR	1.6+0.8	0.96-1.30	1.5+0.6	0.96-1.30	1.6+0.7	0.7345
APTT	30.7+13.1	30-40 s	31.8+19.5	30-40 s	31.1+15.5	0.8528
Time range	1.3+0.7	up to 1.25	1.3+0.8	up to 1.25	1.3+0.7	0.8554
Na	139.7+7.3	137-148 mEq/L	140.3+10.9	137-148 mEq/L	139.9+8.7	0.8753
K	4.4+0.7	3.5-4.5 mEq/L	4.3+1.0	3.5-4.5 mEq/L	4.3+0.8	0.8219
Ca	7.9+1.1	8.8-10.6 mg/dL	7.9+1.1	8.8-10.6 mg/dL	7.9+1.1	0.9065
Mg	2.0+0.4	1.9-2.5 mg/dL	2.1+0.5	1.9-2.5 mg/dL	2.0+0.4	0.6977
U	95.0+55.7	10-45 mg/dL	86.4+58.9	10-45 mg/dL	91.8+56.1	0.6841
C	1.3+0.4	0.6-1.0 mg/dL	1.8+1.8	0.8-1.2 mg/dL	1.5+1.2	03445
Glycemia	144.8+77.5	75-115 mg/dL	130.0+51.4	75-115 mg/dL	139.3+68.3	0.5627
CPK	253.3+845.6	up to 165 U/L	107.6+87.6	up to 190 U/L	198.7+667.9	0.4540
CK-MB	27.8+30.3	<25	20.8+9.5	<25	25.3+24.9	0.3550
Amylase	123.6+164.3	up to 220 UI/L	149.2+290.3	up to 220 UI/L	133.1+215.9	0.7510
Total protein	5.4+1.5	6.4-8.1 g/DL	5.6+0.6	6.4-8.1 g/DL	5.5+0.6	0.6643
Albumin	2.5+0.8	4.0-5.3 g/dL	2.8+0.7	4.0-5.3 g/dL	2.6+0.8	0.3548

Two male elderly patients (5.7%) had pancreatitis; two female ones (5.7%) had upper gastrointestinal bleeding. There was one case of acute pulmonary edema (2.8%), one of deep vein thrombosis (2.8%), and another of acute myocardial infarction 92.8%), all three in female patients.

The mortality rate was 62.8 percent, 31.4 percent of which during hypothermia and 31.4 percent after reversal. The rate was significantly greater (p = 0.0249) for women (73.9%) than men (41.7%) when frequency of death was compared to favorable outcomes of hypothermia. However, the difference disappears when considering patients who died during hypothermia and those who died after reversal as separate variables.

There was no statistically significant difference (p = 0.1459) when comparing mean age of patients with favorable outcomes (73.3_10.3 years) to those who died (78.4_10.0 years). On the other hand, the mean age was significantly higher (p = 0.0202) for women who died after reversal of hypothermia (78.5_10.9 years) than for men (67.0_1.0 years) with the same outcome, but that difference was not found in patients with favorable outcomes nor in patients who died during hypothermia. On the other hand, the mean age of patients who died during hypothermia (81.4_8.77 years) was significantly higher (p = 0.0493) than for those with favorable outcomes (73.7_10.3 years), which in turn was no different (p = 0.1631) than for patients who died after reversal (75.4_10.6 years).

In terms of severity of hypothermia, there was a statistically homogeneous distribution of episodes with favorable outcomes and those in which patients died during hypothermia. On the other hand, patients who died after reversal of hypothermia were significantly more likely to have moderate hypothermia (p = 0.0002) than other outcome groups.

The presence of urinary tract infection (UTI) was significantly more frequent among patients whose outcome was death (p = 0.0184), a difference not found with the presence of bronchopneumonia (BCP) (p = 0.9305). Of patients with pressure ulcers, 25 percent had favorable outcomes; 33.3% died during hypothermia; and 41.7% died even after reversal of hypothermia. This difference was statistically significant (p = 0.0415).

When the results from laboratory tests are compared to case outcomes (Table 4), we see significantly lower albumin counts (p = 0.0315) for patients who died (2.3_0.6) than for those with good outcomes (2.9_0.8). Results for other tests were homogeneous between outcome groups.

Discussion

There are very few published studies about hypothermia in elderly subjects, especially those institutionalized in LTCFs. Most of the literature reviewed mentions only that the elderly are at risk for hypothermia and that they require special attention.[10-14] The literature also mentions that half of the cases of hypothermia admitted to emergency services in the US are of elderly patients[2] (Chart 1).

Our clinical study shows that cases of hypothermia were not infrequent among HGCDP II residents; however, there was no systematic data that allowed us to establish how prevalent the condition was, its seasonality and its root causes. Therefore, we adopted a protocol based on that used at Pronto Socorro Central da Santa Casa de São Paulo,[11] adapted to the profile of HGCDP II residents, with the goal of investigating both the prevalence and the causes and outcomes of hypothermia in this population.

In terms of etiologic factors, hypothermia may be classified as either intentional (induced) or accidental (unintentional), the latter divided into primary (environmental exposure) and secondary (various causes).[11,12] All 35 episodes of hypothermia in this study were cases of accidental hypothermia secondary to an infection. The literature reviewed states that most cases of hypothermia are accidental, especially since they come mostly from the community at large and not from LTCFs.[2,13] Hypothermia in the elderly are known to be usually secondary to comorbidities associated with limited movements and failure of thermoregulatory mechanisms. It is also heavily influenced by behavioral factors, social isolation, and lack of resources.[9]

Epidemiologic data relative to secondary accidental hypothermia, especially in elderly subjects, are rarely published. For younger populations, it has been found that men and women are equally at risk for hypothermia overall, though some published results indicate that prevalence of hypothermia among men might be 2.5 to 4 times greater than for women; the latter findings are justified by higher levels of exposure to environmental risk factors among men.[2,15-17] We should stress that those data refer to various hypothermic conditions (incidental and accidental, primary and secondary) in adult populations.

Among elderly residents of this LTCF, our findings show some peculiarities. First, significantly more women (65.7%) among patients with accidental secondary hypothermia. The difference is even more significant (p = 0.0152) when we consider that the

Table 3 - Mean averages and standard deviation of results from laboratory tests most relevant for hypothermia, distributed by outcome of the 35 episodes of hypothermia in 31 institutionalized patients.

Laboratory tests	Outcome		Total	p
	Favorable	Death		
pH	7.4+0.2	7.3+0.1	7.3+0.1	p = 0.2390
Potassium	4.4+0.8	4.3+0.9	4.3+0.8	p = 0.8013
Albumin	2.9+0.8	2.3+0.6	2.6+0.8	p = 0.0315
Glycemia	139.6+56.9	139.1+78.1	139.3+68.3	p = 0.9838

pH: potential of hydrogen

Chart 1 - Mortality rates for hypothermia reported in literature reviewed for this study.

AUTHOR	YEAR OF PUBLICATION	COUNTRY	STUDY PERIOD	NUMBER OF PATIENTS	NUMBER OF ELDERLY	MORTALITY
Lichtenstein et al.32	1990	Brazil	3 years	20	0	35.0%
Onuchic et al.33	1990	Brazil	NR	36	NR	39.0%
Darowski et al.34	1991	England	1987-1989	25	25	52.0%
Steele et al.35	1996	USA	1991-1993	16	NR	6.25%
DMTM CHAMONIX36	1998	France	1988-1996	117	NR	22.0%
Kornberger et al.6	1999	Austria	1995-1998	15	9	40.0%
Graham et al.37	2001	Scotland/ England	Dec/2003- Mar/2004	73	NR	36.0%
McInerney et al.19	2002	England	NR	8	7	50.0%
Muszkat et al.13	2002	Israel	1986-1999	67	67	46.0%
Pedley et al.29	2002	Scotland	Oct-Dec/1999	48	48	34.0%
Golin et al.11	2003	Brazil	1987-2001	212	63	38.2%
Silfvast e Pettilä38	2003	Finland	1991-2000	75	NR	12.0%

NR (no reference).

initial universe of our study (483 elderly) consisted of 254 men (52.5%), 12 of which (4.7%) had hypothermia, and 229 women (47.5%), 23 of which (10%) did so. At first, the data could indicate institutionalized elderly women are 2.2 more susceptible to hypothermia, but we would need a more comprehensive controlled study to prove that assertion. Consider also that the mean age of women with hypothermia was significantly higher ($p = 0.0098$) than that of men with the condition, and that the being older is a risk factor for alterations in one's thermoregulatory center that may lead to hypothermia.[5,15,18,19]

This population of elderly individuals also had frequent associations of diseases, the timing of which might interfere with the hypothalamic thermostat.[15,17] Most elderly (74.3%) had four or more associated comorbidities, the most frequent being systemic hypertension for practically all patients (91.4%), followed by dementia syndrome (71.4%), immobility (68.8%), pressure ulcers (68.2%), sequelae from strokes (57.2%), and DM (57.2%). Except for DM, significantly more common among women, and sequelae from strokes, significantly more common among men, the frequency of comorbidities was similar for both genders.

Various authors report that drops in core temperature in elderly patients are a consequence of exposure to low temperatures associated with other secondary causes.[2,7,9] Most of our elderly subjects (82.9%) was, however, wearing appropriate warm clothing, and the mean environmental temperature recorded for 19 of the 35 episodes was 21.4_3.7°C at the onset of hypothermia. Also, weather minimums recorded in São Paulo in 2004[22] in the region of the LTCF in this study were not so low as to explain exposure of properly dressed elderly to temperatures below adequate. We are left to infer that, for this population, the failure of thermoregulatory centers producing decreased production or increase in heat loss[11,14] must have been caused by various factors not directly associated with exposure to low temperatures.

In the literature, another frequent event associated with hypothermia in elderly subjects is falls, especially when these result in trauma, immobility and loss of conscience, situations in which subjects may be exposed to progressive loss of temperature.[9,21,23] Our sample included four episodes of recent falls (approximately 10 percent of cases), but they were unrelated to the hypothermia.

Polypharmacy is not unusual among institutionalized elderly; in the population in this study, suffering from a significant number of associated comorbidities, polypharmacy was widespread. It is general knowledge that drug interactions and abuse of certain psychotropic agents can further increase the risk of onset of hypothermia.[23] In addition, several classes of medications prescribed to elderly patients may induce hypothermia by heat loss, such as antipsychotics and antihypertensive alpha-blockers.[23-26]

The high number and category of comorbidities, both clinic (hypertension in 91.4 percent of cases) and psychiatric (dementia syndrome in 71.4 percent of cases reported here) in our group imply constant use of medications, especially antihypertensives and various psychotropic antidepressants and/or antipsychotics, prescribed for 37.1 percent of the cases in this study. To establish that polypharmacy did indeed represent a predisposing factor of hypothermia in this sample, we should have better assessed the quantity and quality of pharmaceuticals prescribed and administered to patients with hypothermia, compared to those who did not suffer hypothermia during the same period. This limits our discussion to descriptive data only, and underlines the need for further research on the subject.

We should also note that most cases had high degrees of dependence (Katz index "F" and "G"), giving them greater frailty and possible higher risks for development of hypothermia.

The severity and time of onset of hypothermia can usually be seen in signs and symptoms, though such clinical manifestations are not always directly related to the severity of the status,[12] so much so that shaking and chills, described as classical signs of hypothermia, may not be present in elderly patients, for whom having the abdominal skin cold to the touch is a more frequent sign.[14]

ECG alterations may be a common consequence of hypothermia,[27] and are one of the most often described, identified as an Osborn wave (widening of QRS complex with positive deflection at its tail end), usually found in temperatures below 32°C and most visible in left derivations.[28,29] However, despite the fact that there was moderate or severe hypothermia in 31.4 percent of cases, the Osborn wave was found in only one case. Perhaps the delay before performing the test, which took place during rewarming or after reestablishment of core temperature, explains the low frequency. We should stress that this fact led us to review the protocol, making the ECG a primary test when diagnosis hypothermia.

In our sample, mean values relative to laboratory tests showed altered values for Hb, Ht, leukocytes, PT, AP, Ca, U, C, glycemia, CPK, total protein, and albumin, comprehending both the clinical comorbidities found and the drug therapies used by the subjects. Also, isolated (40.0%) or associated (60.0%) infections were identified for all patients: 80 percent had BCP, while 60 percent had UTI. Other infections included infected pressure ulcers (17.1%), gangrene (2.8%), osteomyelitis (2.8%), and peritonitis (2.8%). Infections were found in association in most cases (60.0%).

Septicemia is both the primary cause and the worst prognosis for accidental hypothermia in elderly patients, and reports indicate 80 percent of elderly subjects with hypothermia are in septic shock.[18] During septicemia, the hypothalamic fixed pointed shifts downwards, leading to abnormal hypothalamic responses, causing excessive peripheral vasodilation and a drop in the subject's metabolic rate, which in turn leads the body to cool down.[24] It is suggested that this mechanism is activated by increased cytokine response,[3] as well as high levels of TNF-a, interleukin-6, prostaglandins, and thromboxane B2 metabolites.[18,19] Except for one patient, all other elderly (97.1%) in this study progressed to septic shock, and 22.8 percent also experienced respiratory failure.

In this sample of institutionalized elderly, the global mortality rate exceeded 60 percent, with half of the deaths occurring during hypothermia and the other half after reversal through rewarming. This mortality rate for institutionalized elderly patients is within the 50 to 80 percent range reported for American elderly populations[2] (which possibly included institutionalized and noninstitutionalized groups), though we should stress that 50 percent of deaths from hypothermia among American elderly individuals occur in their homes.[17]

On the other hand, the mortality rate is higher than those found in other studies of hypothermia in the general population. In studies with only elderly subjects,[14,20,30], though not institutionalized elderly, mortality rates range from 34.0 to 52.0 percent. The numbers allow us to consider whether the mortality rate for institutionalized elderly should not in fact be higher than for the noninstitutionalized.

The literature reviewed offered no studies that could serve as a parameter for discussing our results in relation to some variables connected to mortality. For example, we found that the global mortality rate was significantly higher for female patients, and that their age was significantly higher than for men only when considering deaths after reversal of hypothermia. Overall, however, the ages of patients who died during hypothermia was significantly higher than for patients with favorable outcomes, though similar to those who died after reversal.

The same inference cannot be made in relation to just advanced age without considering the gender of the elderly subjects for mortality after reversal of hypothermia, strongly associated with moderate hypothermia. On the other hand, advanced age may be an independent risk factor for mortality during hypothermia, especially when we consider that patients with this outcome had similar frequencies of mild and moderate hypothermia. Keep in mind, though, that we found higher frequencies of moderate among male patients.

There was a higher incidence of infection in patients with dementia syndrome and/or high degrees of dependence.[31,32] Once again, 71.4 percent of patients in this study had dementia syndrome, and 77.1 percent had high degrees of dependence (Katz index "F" and "G"[13]). Our data also showed the outcome of death was significantly associated with the presence of UTI, lower albumin levels, and presence of pressure ulcers.

This study is relevant because it provides the literature with data about the prevalence and outcome of hypothermia, currently too sparse when it comes to institutionalized elderly. Also, the high mortality rate for this population, even greater than in the general population, requires us to consider, develop and implement stricter surveillance for infections. This assumes a wider and more careful geriatric approach to fight mortality secondary to accidental hypothermia in institutionalized elderly patients.

Conclusion

According to the objectives set out for this prospective study, we may conclude that:

- there was a 7.2 percent annual prevalence of accidental hypothermia in this sample of institutionalized elderly, whose mean age was 76.4_10.6 years;

- the most common comorbidities among the institutionalized elderly included systemic hypertension (91.4%), dementia

syndrome (71.4%), immobility (68.6%), pressure ulcer (68.2%), and previous history of acute cerebrovascular attacks (57.2%);

- accidental hypothermia was mainly secondary to bronchopneumonia (80.0%) and urinary tract infections (60,0%);

- there was a 62.8 percent mortality rate for this population during hypothermia or after reversal;

- the occurrence of death, especially after reversal of hypothermia, was positively correlated with being older, female, having a moderate degree of hypothermia, lower albumin values, and presence of a urinary tract infection or pressure ulcer.

We thus see that institutionalized elderly patients with several comorbidities and high degrees of dependence require greater attention from interdisciplinary teams regarding the prevention of infections and early diagnosis of hypothermia, thus decreasing the mortality rate for this serious clinical condition.

New studies, including base temperature for chronic and/or institutionalized patients, should add to the current body of knowledge about accidental hypothermia in long-term care facilities for the elderly.

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