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Hypoglycemia in Spanish emergency departments: current situation and prospects

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OBJECTIVE. To describe the characteristics of patients attended for hypoglycemia in emergency departments (EDs), the causes of hypoglycemic episodes, and treatments prescribed. To evaluate adherence to the consensus-based treatment guidelines issued by Spanish scientific associations.

METHODS. Retrospective multicenter cohort study of cases treated in 11 Spanish hospitals (3, tertiary care; 8, secondary care). We reviewed records for patients over the age of 18 years attended for hypoglycemia in EDs between July 1, 2018, and July 31, 2019. Multiple logistic regression analyses were performed.

RESULTS. A total of 978 patients (51.1%, men) were included. The median age was 73.3 years. The median hospital stay was 1 day; 90.3% of the patients had diabetes (82.3%, type 2), and 76.9% had a Charlson Comorbidity Index of 3 or higher. Insulin was the antidiabetic treatment the majority (72.6%) were using. Inadequate caloric intake was the most common cause of hypoglycemia (in 29.8%). A dextrose solution (5% or 10%) was used to correct hypoglycemia in 58.7%. Treatment in acute cases of hypoglycemia followed protocols in 36.2% of the ED cases; at discharge, treatment protocols were followed in 50.5% of cases. ED revisits were recorded for 23.6% at 30 days and for 36.8% at 90 days. Metabolic decompensation accounted for 26% of revisits within 30 days and 23% within 90 days. The 30-day and 90-day mortality rates were 6.7% and 8.9%, respectively. Hazard ratios (HRs) indicated that adherence to established protocols on discharge was associated with lower probability of ED revisiting at 30 days and 90 days, respectively, as follows: HR 0.45 (95% CI, 0.35-0.58) and HR 0.37 (95% CI, 0.26-0.53) for all-cause revisits; and HR 0.37 (95% CI, 0.19-0.72) and HR 0.44 (95% CI, 0.26-0.74) for revisits related to metabolic decompensation.

CONCLUSIONS. The most common profile of patients treated for hypoglycemia in EDs is a frail person of advanced age with type-2 diabetes under treatment with insulin. Inadequate caloric intake is the most common cause of hypoglycemic emergencies. Emergency physicians' adherence to established protocols for treating hypoglycemia is low. Adherence to protocols for prescribing antidiabetic treatment at discharge is also low. Adherence is an independent factor that reduces the frequency of revisits, either for all causes or for metabolic decompensation.

Keywords: Hypoglycemia. Diabetes mellitus Emergency department.

Hipoglucemia en las urgencias hospitalarias españolas: situación actual y pronóstico. Estudio global SAHU

OBJETIVO. Describir las características del sujeto atendido por hipoglucemia en un servicio de urgencias, sus causas y los tratamientos prescritos. Evaluar la adherencia al protocolo de consenso de hipoglucemias vigente de las sociedades científicas españolas implicadas en su tratamiento.

MÉTODO. Estudio de cohorte retrospectivo en 11 hospitales españoles (3 terciarios, 8 secundarios). Se revisaron todos los sujetos mayores de 18 años atendidos en urgencias hospitalarias (SUH) por hipoglucemia, entre el 1 de julio de 2018 y el 31 de julio de 2019. Se realizó un modelo de regresión logística múltiple.

RESULTADOS. Se incluyeron 978 pacientes (51,1% varones). La mediana de edad fue de 73,3 años, con una mediana de estancia hospitalaria de 1 día. El 90,3% de los sujetos eran diabéticos (82,3% tipo 2) y el 76,9% tenían una puntuación en la escala de Charlson ≥ 3 puntos. La insulina fue el fármaco antidiabético más utilizado (72,6%). La baja ingesta de alimentos fue la causa más frecuente de hipoglucemia (29,8%). El tratamiento más utilizado para corregir la hipoglucemia fue la dextrosa sérica al 5 o 10%

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(58,7%). La adherencia al protocolo de tratamiento de la hipoglucemia fue del 36,2% y del 50,5% al alta. A los 30 y 90 días después del alta, el 23,6% y el 36,8% de los sujetos, respectivamente, volvieron a visitar el SUH. Se encontró una etiología metabólica en el 26% y el 23%, y una mortalidad a los 30 y 90 días del 6,7% y el 8,9%, respectivamente. La adherencia al protocolo de manejo establecido al alta redujo las visitas de seguimiento por todas las causas y específicamente por causas metabólicas a los 30 y 90 días: HR 0,45 (IC 95%: 0,35-0,58) y 0,37 (IC 95%: 0,26-0,53) para todas las causas, y HR 0,37 (IC 95%: 0,19-0,72) y 0,44 (IC 95%: 0,26-0,74) para la causa metabólica, respectivamente.

CONCLUSIONES. El sujeto más frecuentemente tratado por hipoglucemia en los SUH es un sujeto anciano, frágil y diabético tipo 2 en tratamiento con insulina. La causa más común de hipoglucemia es la baja ingesta de alimentos. La adherencia de los médicos de urgencias a los protocolos establecidos de hipoglucemia es baja, así como al protocolo de alta con tratamiento antidiabético. Esta adherencia reduce de forma independiente las visitas de seguimiento por causa metabólica o por cualquier causa.

Palabras clave: Hipoglucemia. Diabetes mellitus. Servicios de urgencias.

Introduction

Diabetes mellitus (DM) is a highly prevalent chronic disease in Spain, affecting around 14% of the population, with a high number of undiagnosed individuals.[1] The percentage of individuals with DM admitted to emergency departments (EDs) ranges between 30 and 40% according to previous studies, frequently due to some complication associated with DM.[2] One of these complications is hypoglycemia, which may require hospital admission,[3] increases short-term mortality,[4] the length of stay[5] and financial costs.[6,7] Emotional sequelae will also influence the subsequent treatment of the underlying disease.[8,9] Recent studies reveal that there are between 1 and 4 acute complications directly related to DM in Eds.[10] Furthermore, the incidence rate of hypoglycemia in emergencies is approximately 16 cases per 1,000 people/year, with a mortality rate of 0.9 per 1,000 people/year.[11] Due to these problems related to hypoglycemia, the Spanish Scientific Societies of Emergencies and Endocrinology (SEMES, SED and SEN) developed medical protocols to standardize and optimize acute and discharge treatments.[12,13]

On the other hand, concomitant infections, dietary transgressions and iatrogenia have been described as the most frequent causes of hypoglycemia.[11] Individuals diagnosed with DM who develop hypoglycemia are most frequently on insulin therapy, particularly in a basal-bolus regimen, followed by oral antidiabetic drugs.[10,14] However, these studies did not consider previous DM control and were conducted before the use of new diabetes treatments. For these reasons, new studies have emerged in Europe showing a reduction in ED visits and hospitalizations due to hypoglycemia due to new treatment options.[15] However, it is unknown whether the most recent changes in DM treatment protocols have reduced the number of hypoglycemia events treated in Spanish EDs, ED revisits and associated morbidity, which are the objectives of this study.

Material and methods

We conducted a multicenter, retrospective, and observational study. Spanish EDs with at least one of their physicians from the Spanish Society of Emergency Medicine (SEMES) (112 centers) were invited to participate, of which 11 agreed to participate. The recruitment period began on July 1st, 2018, and ended on July 31st, 2019. All patients aged 18 or older with and without a prior diagnosis of DM, admitted to the EDs, whose reason for consultation was a hypoglycemic event or that was detected and recorded during their stay in the EDs, were included. As this was an observational study, a sample size calculation was not performed, considering that the wide time frame was sufficient for the sample to be representative.

The following demographic and clinical data were recorded as independent and descriptive variables: age, sex, hypertension, DM and its treatment, dyslipidemia, alcohol consumption, ischemic heart disease, heart failure, peripheral vascular disease, stroke, chronic obstructive pulmonary disease, cognitive impairment, chronic kidney disease, chronic liver disease, scores on the Charlson and Glasgow coma scales, as well as vital signs on arrival at the ED.

Infection, low food intake, medication administration errors, and poor disease control were considered as causes of hypoglycemia. Poor disease control was diagnosed following the criteria of the American Diabetes Association (ADA),[16] which establishes it as such when the patient does not have an infectious trigger, no treatment error has occurred, situations of low food intake have been ruled out, and there is certainty of poor prior glycemic control.

To evaluate adherence to hypoglycemia protocols in EDs, the primary endpoint variables were those included in the acute complications protocol: a) oral treatment, b) IV glucose, c) intramuscular glucagon injection, d) IV hydrocortisone, and e) IV adrenaline, and the discharge treatment management protocol.

The secondary endpoint variables were: a) hypoglycemia during admission (venous blood glucose < 60 mg/dL or capillary < 70 mg/dL), b) hyperglycemia after hypoglycemia (venous or capillary blood glucose > 180 mg/dL) within the next 24 hours following admission to the EDs, c) ED revisits at 30 and 90 days after discharge, d) readmission to the hospital ward at 30 and 90 days, and e) mortality at 30 and 90 days after discharge.

Data were obtained by reviewing the electronic medical records of the EDs. Follow-up of complications at 30 and 90 days was also obtained by reviewing the computerized clinical history. Metabolic decompensation as a cause of revisit was defined as any acute complication of DM.

The study protocol was ethically approved by the Institutional Review Board (IRB) of Ethics and Clinical Research

11 HOSPITALS

- Hospital Clínico San Carlos (Madrid)
- Hospital Universitario de Fuenlabrada (Madrid)
- Hospital de La Ribera (Valencia)
- Hospital Universitario de Galdakao (Vizcaya)
- Hospital de Guernika (Vizcaya)
- Hospital de Barsuto (Vizcaya)
- Hospital San Pedro (Logroño)
- Hospital Universitario Central (Asturias)
- Hospital Universitario de Vinalopó (Alicante)
- Hospital Universitario Joan XXIII (Tarragona)
- Hospital Santa Bárbara (Soria)

N = 978 PATIENTS

Figure 1. Participating hospitals in Spain.

of *Hospital Clínico San Carlos*. The study was conducted following the Declaration of Helsinki.

Statistical analysis

Absolute and relative frequencies were used for categorical variables. For continuous variables, measures of central tendency and dispersion were used: mean and standard deviation (SD), or median and interquartile range (IQR) in case of asymmetry of the variables. The chi-square test or Fisher's exact test was used to compare categorical variables, while Student's t-test or the median test was applied to continuous variables.

Adherence to emergency protocol recommendations was evaluated by generating a multiple logistic regression model that included the following adjustment variables: age, Glasgow coma scale score on admission, Charlson scale score, and time since DM diagnosis. The size of the associations was presented using the adjusted hazard ratio (HR), and statistical significance was evaluated using 95% confidence intervals (CI) and p-values. Inter-group differences were statistically significant when the *P*-value was < .05. Statistical analysis was performed with the SPSS statistical package (IBM Corp).

Results

A total of 978 patients from 11 EDs were included (Figure 1). Information on the date of DM diagnosis, as well as glycated hemoglobin (HbA1c) in the previous 3 months, could not be collected in all cases as it was not available in the clinical history.

Comorbidities and personal history

The characteristics related to comorbidities and personal history, as well as the concomitant treatment of patients with a prior diagnosis of DM before admission, are shown in Table 1 and Figure 2. The median age of the patients (51.1% men) was 73.3 years (IQR, 58.7-83.35). A total of 10% of the patients were not diabetic, and 76.6% of the patients had a Charlson scale score > 3. In the DM group with HbA1c performed in the previous 3 months, a median DM evolution time of 15 years (IQR, 10-20) and an HbA1c of 7.48% (SD 1.62) were found.

Regarding treatment, the most common combination was that of non-insulin hypoglycemic agents (NIHA), which represented 43.6% of the total patients. Regarding individuals on insulin treatment, 43.1% of cases were treated with basal-bolus therapy. The median daily dose of insulin units in this group was 38 IU (IQR, 24-56).

Clinical characteristics

Clinical characteristics are shown in Table 1. In 31.9% of patients, blood glucose on admission to the emergency department was not recorded. In addition, 33.5% of patients had recurrent hypoglycemia during their hospital stay.

The causes of hypoglycemia are shown in Figure 3. Those patients who developed hyperglycemia after hypoglycemia during their hospital admission had longer lengths of stay [median, 1 day (IQR, 0-2) vs 1 day (IQR, 0-3), *P* = .02)].

Regarding therapeutic management in the ED, most patients were treated with 5% or 10% dextrose serum (58.7%), or 50% glucose solution (34.6%). Oral diet treatment was administered in only 49% of patients. Other possible treatments included in the hypoglycemia protocol were used in < 10%.

Follow-up complications

The most common cause of revisit at 30 and 90 days was metabolic decompensation (26% and 22.6% at 30 and

Table 1. Main demographic and clinical characteristics of the patients according to adherence to the protocols

	Global N (%)	Acute hypoglycemia treatment protocol N (%)	No acute hypoglycemia treatment protocol N (%)	*P*	Discharge treatment protocol N (%)	No discharge treatment protocol N (%)	*P*
Total	978	354 (36)	619 (64)		432 (50.53)	423 (49.47)	
Age (years)	73.31 RI (58.7-83.35)	67.71	69.49	.19	70.25	70.26	.99
Sex							
Male	490 (50.1)	186 (52.5)	303 (48.9)	.29	218 (50.5)	215 (50.8)	.92
Female	488 (49.9)	168 (47.5)	316 (51.1)		214 (49.5)	208 (49.2)	
Ischemic heart disease	203 (20.8)	70 (19.8)	133 (21.3)	.57	94 (21.8)	98 (23.2)	.62
Heart failure	173 (17.7)	57 (16.1)	115 (18.6)	.46	79 (18.3)	80 (18.9)	.59
Vascular disease	198 (20.2)	61 (16.9)	137 (22)	.06	83 (19.2)	99 (23.4)	.13
Stroke	143 (14.6)	47 (13.1)	96 (15.5)	.29	70 (16.2)	62 (14.7)	.53
Hypertension	673 (68.8)	231 (65.4)	439 (71)	.07	316 (73.3)	310 (73.3)	.99
Dyslipidemia (DI)	560 (57.3)	203 (57.5)	355 (57.4)	.96	264 (61.3)	263 (62.2)	.78
DM	883 (90.3)	----------	----------		----------	----------	
Type of DM (n = 883)							
Type I	156 (16)	59 (18.9)	96 (17)	.47	86 (19.9)	70 (16.5)	.2
Type II	727 (74.3)	253 (81.1)	470 (83)		346 (80.1)	353 (83.5)	
No DM	95 (9.7)	----------	----------		----------	----------	
Duration of DM (years) (n = 835)							
< 5 years	90 (10.78)	35 (12.96)	55 (11.7)	.49	43 (11.7)	44 (12.3)	
6-10 years	99 (11.86)	35 (12.96)	64 (13.62)		51 (13.8)	44 (12.3)	
> 10 years	551 (65.99)	200 (74.08)	351 (74.68)		275 (74.5)	271 (75.5)	
HbA1c % (n = 555) [mean (SD)]	7.48 DE (1.62)	7.53 DE (1.66)	7.43 DE (1.55)	.51	7.45 DE (1.54)	7.66 DE (1.66)	.14
Dementia	141 (14.4)	46 (13)	94 (15.2)	.35	69 (16)	56 (13.2)	.26
Baseline functional status							
IADL	678 (69.3)	255 (72)	419 (67.7)	.08	295 (68.3)	300 (70.9)	.52
PDADL	202 (20.7)	60 (16.9)	142 (22.9)		93 (21.5)	89 (21)	
DADL	98 (10)	39 (11)	58 (9.4)		44 (10.2)	34 (8)	
COPD	116 (11.9)	38 (10.7)	68 (12.6)	.38	39 (9)	69 (16.4)	**.01**
Liver disease	97 (9.9)	29 (8.2)	67 (10.8)	.19	38 (8.8)	47 (11.1)	.25
Renal failure	321 (32.8)	114 (32.2)	205 (33.1)	.77	143 (33.1)	155 (36.6)	.28
Alcoholism	94 (9.6)	27 (7.6)	66 (10.7)	.13	31 (7.2)	49 (11.9)	**.03**
Charlson Comorbidity Index ≥ 3	750 (76.7)	258 (73.1)	490 (79.4)	**.02**	338 (21.4)	347 (17.8)	.18
Glasgow Coma Scale at arrival							
≤ 8	17 (1.7)	15 (4.2)	2 (0.3)	**< .001**	7 (1.6)	7 (1.7)	.77
9-13	86 (8.8)	44 (12.5)	42 (6.8)		40 (9.3)	33 (7.9)	
14-15	871 (89.4)	294 (83.3)	572 (92.9)		385 (89.1)	380 (90.5)	
Blood glucose upon arrival (mg/dL) [median (IQR)]	66 RI (49-107)	65 RI (48-107)	66 RI (49-106)	.75	65 RI (46-107)	66 RI (50-116)	.2
Length of stay (days) [median (IQR)]	1 RI (0-3)	1 RI (0-3)	1 RI (0-5)	**.02**	----------	----------	
Hyperglycemia on admission	382 (39.1)	97 (27.4)	284 (45.9)	**< .001**	180 (41.7)	184 (43.6)	.57

DM: Diabetes Mellitus; COPD: Chronic Obstructive Pulmonary Disease; IADL: Independent for Basic Activities of Daily Living; DADL: Dependent for Basic Activities of Daily Living; PDADL: Partially Dependent for Basic Activities of Daily Living.

90 days, respectively), requiring hospital admission in 10% and 16%, respectively. The most common cause of death at 30 and 90 days was infection (33.3% in both cases) followed by metabolic decompensation (16.7% and 15.3%, respectively).

The results in the application vs non-application of acute hypoglycemia treatment protocols, as well as the discharge treatment protocol, are shown in Table 2. Low adherence to recommended protocols was observed, both in the treatment of acute hypoglycemia and in hospital discharge management. The comparison of acute hypoglycemia protocol application vs non-application showed no differences in the number of revisits at 30 and 90 days, nor in readmissions or deaths at 30 and 90 days. However, in those patients whose treatment followed the acute hypoglycemia protocol, a lower rate of rebound hyperglycemia was observed (27.4% vs 45.9% respectively, $P < .01$). This rebound hyperglycemia led to more hospital admissions, as patients who did not present hyperglycemia stayed fewer days in the hospital [1 (IQR, 0-3) vs 1 (IQR, 0-5) days respectively, $P = .02$]. In addition, those patients with correct prescription following the discharge protocol had fewer all-cause ED revisits at 30 and 90 days (11.8% vs 28.4% at 30 days, $P < .001$; and 23.7% vs 45.7% at 90 days, $P < .001$) and were readmitted less at 30 and 90 days (5.1% vs 13.6%, $P < .001$ and 11.4% vs 20%, $P = .001$, respectively).

The differences remained when the multivariable adjustment was performed using Kaplan-Meier curves, with a 60% risk reduction in both time analyses. Similarly, we also found significant differences in reconsultations at 30 and 90 days for metabolic causes: HR, 0.37 (95% CI, 0.19-0.72) and HR 0.44 (95% CI, 0.26-0.74) at 30 and 90 days, respectively. Lower readmission at 30 and 90 days (5.1% vs 13.6%, $P < .001$ and 11.4 vs 20%, $P = .001$) was also ob-

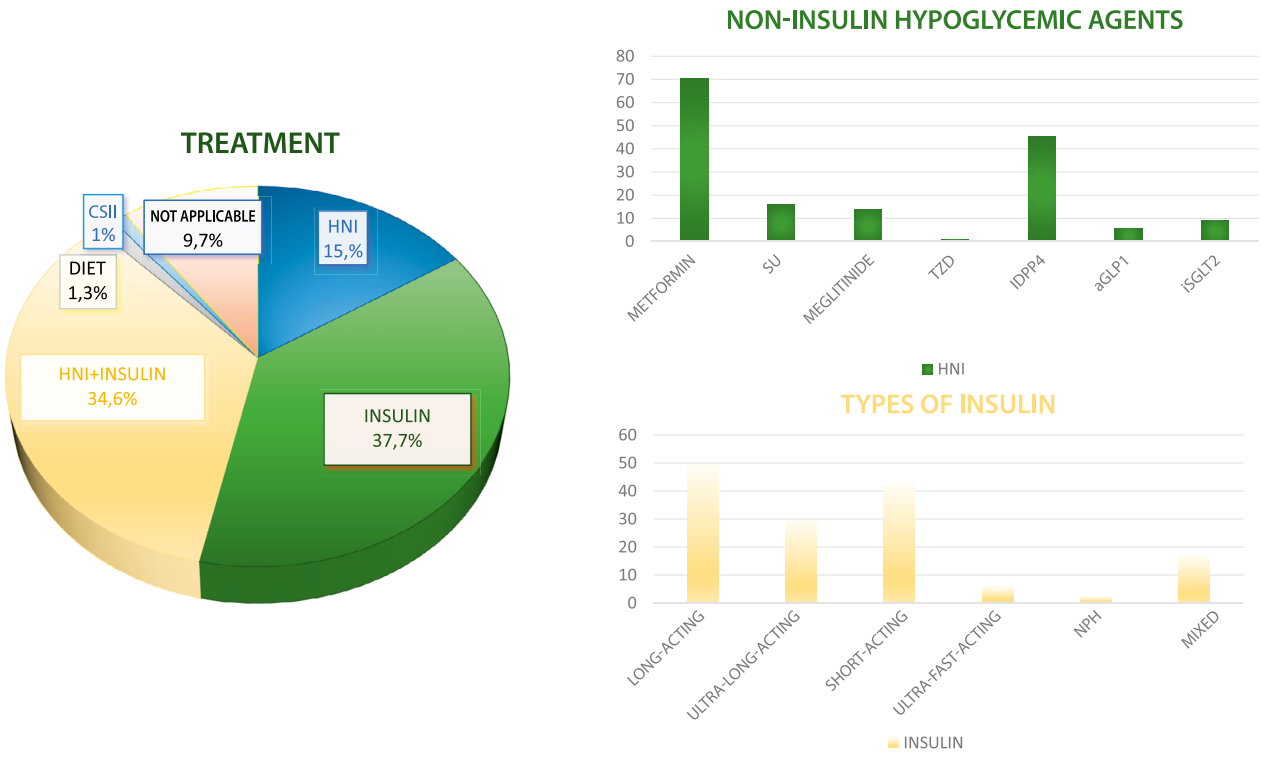

Figure 2. Treatments of patients with diabetes mellitus.
GLP1a: Glucagon-like peptide-1 agonists; NIHA: Non-insulin hypoglycemic agents; SGLT2i: sodium-glucose cotransporter-2 inhibitors; NPH: intermediate-acting human insulin; SU: sulfonylureas.

served in patients whose treatment followed the discharge prescription protocol. Regarding mortality, differences were only found at 90 days, with lower all-cause mortality in the group of patients adherent to the discharge treatment protocol compared to the non-adherent group (3.7 vs 7.1%, *P* = .03).

Finally, the survival curves (Figure 4) demonstrated statistically significant reductions in the risk of ED revisit at 30 and 90 days in those subjects whose treatment followed the discharge protocol: HR, 0.39 (95% CI, 0.27-0.53) and HR, 0.4 (95% CI, 0.35-0.56)] for 30 and 90 days respectively.

Discussion

As far as we know, this is the first study to describe the clinical characteristics of patients diagnosed with hypoglycemia in Spanish EDs. It is a large sample, with almost 1,000 patients, mostly type 2 diabetics. Only 10% of the individuals included with hypoglycemia were non-diabetic, a lower proportion than in previous studies.[17] An important finding of this study is the improvement in the prognosis of patients diagnosed with diabetes who suffer a hypoglycemic episode and are discharged following the SEMES, SED and SEN protocols. This improvement is demonstrated by the lower proportion of ED revisits at 30 and 90 days after discharge, as well as the decreased probability of death at 90 days. Moreover, the typical patient with hypoglycemia in our work was an elderly, frail individual with several cardiovascular risk factors and high comorbidity, consistent with other studies.[18]

On the other hand, most diabetic patients treated in the EDs showed poor prior glycemic control according to ADA criteria,[16] as well as a long prior duration of the disease, since 75% of individuals had been diagnosed > 10 years earlier, which is also consistent with previous studies.[19] Regarding diabetes treatment, most patients (> 70%) were on treatment with high amounts of insulin, alone or in combination with NIHA, more frequently combinations of long-acting and rapid-acting insulins. These results are partly correlated with previous literature.[19] Moreover, only 15% of individuals were treated exclusively with NIHA, a lower proportion than other series.[11,21,22] The most likely reason for this finding could be that treatment with secretagogues, especially sulfonylureas, has fallen sharply in Spain in recent years, according to data from the Spanish Ministry of Health.[23]

Among the causes of hypoglycemia, low food intake is the main reason (1 in 3 patients), followed by poor dia-

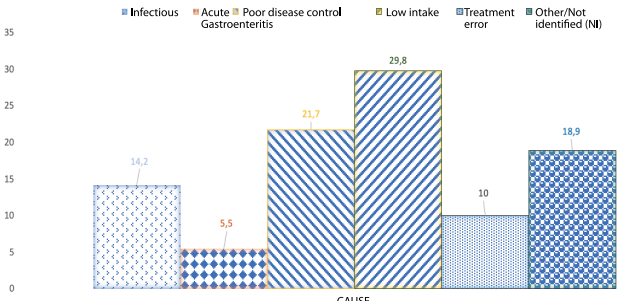

Figure 3. Causes of hypoglycemia.

Table 2. Revisit, readmission, and death at 30 and 90 days after discharge according to adherence to the protocols

	Global	Cause		Protocol acute treatment hypoglycemia (N = 354) 36%	No protocol acute treatment hypoglycemia (N = 619) 64%	*P*	Discharge treatment protocol (N = 432) 50,53%	No discharge treatment protocol (N = 423) 49,47%	*P*
30-Day Revisits	182 (19.4%)	Infectious	47 (21.1%)	65 (19.1%)	117 (19.6%)	.93	51 (11.8%)	119 (28.4%)	< .001
		Cardiovascular	18 (8.1%)						
		Metabolic	58 (26%)						
		Other/NC	100 (44.8%)						
90-Day Revisits	319 (34.2%)	Infectious	71 (20.5%)	116 (34.2%)	203 (34.2%)	1	102 (23.7%)	190 (45.7%)	< .001
		Cardiovascular	33 (9.5%)						
		Metabolic	78 (22.6%)						
		Other/NC	164 (47.4%)						
30-Day Readmissions	82 (8.8%)	----------		26 (7.6%)	56 (9.4%)	.40	22 (5.1%)	57 (13.6%)	< .001
90-Day Readmissions	138 (14.8%)	----------		46 (13.6%)	92 (15.5%)	.45	49 (11.4%)	83 (20%)	.001
30-Day Mortality	53 (5.5%)	Infectious	18 (33.3%)	24 (6.8%)	29 (4.7%)	.19	7 (1.6%)	14 (3.3%)	.13
		Cardiovascular	8 (14.8%)						
		Metabolic	9 (16.7%)						
		Other/NC	19 (35.2%)						
90-Day Mortality	80 (8.3%)	Infectious	24 (33.3%)	33 (9.3%)	47 (7.7%)	.4	16 (3.7%)	30 (7.1%)	.03
		Cardiovascular	8 (11.1%)						
		Metabolic	11 (15.3%)						
		Other/NC	29 (40.3%)						

betes control in 21.7% of cases. This difference with other studies, where infections or treatment errors were more frequent,[11] seems related to the higher proportion of elderly, frail subjects with significant comorbidity in this cohort, as well as the high number of them treated with insulin.

Regarding the treatment of hypoglycemia in EDs, we want to highlight the more frequent use of 5 or 10% dextrose solutions (60% of cases), followed by oral glucose replacement in a percentage close to half of the patients. This data is particularly worrying since treatment guidelines[13,16] indicate that the treatment of choice is carbohydrate intake. As most patients arrived at the ED with an adequate level of consciousness according to the Glasgow coma scale, adherence to established protocols is low in this regard.

On the other hand, we must emphasize that discharge treatment in most patients remained unchanged, with the most frequent treatments being insulin alone or in association with NIHA, most frequently a daily long-acting insulin. The proportion of patients treated at discharge with the new ultra-long-acting insulins is still very small, although their lower risk of hypoglycemia is already known[23,24]. Among the causes, we could think of therapeutic inertia, the still limited knowledge of these new insulins by ED physicians, as well as barriers to their prescription such as the need for treatment authorization.

Another important finding of this study is that 1 in 5 and 1 in 3 patients, respectively, reconsulted at the ED in the following 30 and 90 days after discharge. The most common cause in both cases was metabolic. Betten *et al.*[19] found a 5.1% reconsultation in the ED within the next 48 hours following discharge, a result difficult to compare with ours at 30 and 90 days.

Regarding mortality at 30 and 90 days, we have found high rates (5.5% and 8.3% respectively). These results are difficult to compare between studies, as the periods of hypoglycemia considered in each of them are different.[17]

Finally, we found low adherence to treatment protocols at the time of hypoglycemia diagnosis and at discharge. Adherence to the hypoglycemia protocol treatment did not lead to differences in terms of revisit, readmission to the hospital ward or mortality. However, adherence to the discharge treatment protocol did lead to a 60% reduction in the probability of revisit for any reason at 30 and 90 days, a result that persisted when the analysis was repeated considering only metabolic causes. Moreover, a significantly low proportion of readmission to the ward at 30 and 90 days was found, as well as a decrease in mortality at 90 days. These findings reinforce the need to disseminate and urge emergency physicians to use the protocols developed by scientific societies, given the high morbidity and mortality associated with hypoglycemia.[25]

This study presents several limitations. The first is inherent to its retrospective and observational design. The loss of information due to its absence in electronic records is another bias. Some medical histories did not have the cause of hypoglycemia recorded, or alternatively, the diagnosis of hypoglycemia could not be identified by the physician. Therefore, non-infectious causes of hypoglycemia, especially and particularly poor diabetes control, may have been underdiagnosed in our study. Secondly, only 11 of the 112 EDs agreed to participate, so there could be poor territorial representation. However, the high number of patients included, close to a thousand, as well as the geographical distribution of the centers greatly reduces this possible bias.

In conclusion, patients treated for hypoglycemia in Spanish EDs are more frequently frail elderly with high associated comorbidity. The main trigger for a hypoglycemic event is low food intake. Low application of hypoglycemia treatment protocols has been found in the acute phase, as

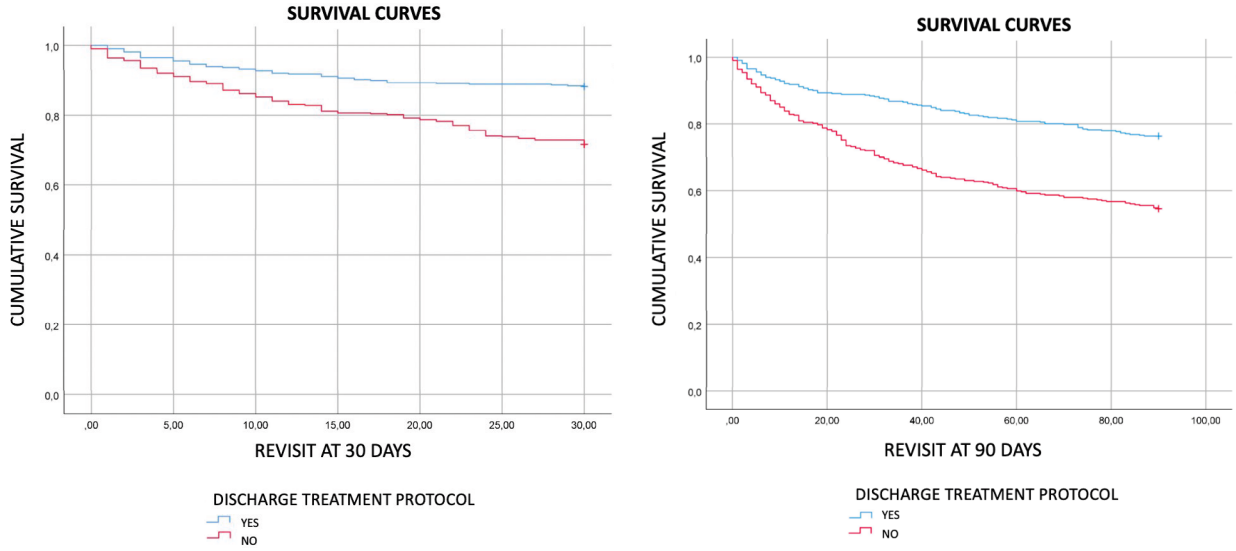

Figure 4. Kaplan-Meier survival curves according to adherence to protocols.
Both curves have been adjusted for age, Glasgow scale score on arrival, Charlson scale score and time since DM diagnosis.

well as at discharge, despite the fact that they clearly improve the survival prognosis at 90 days, also reducing the number of reconsultations and readmissions to the hospital ward at 30 and 90 days. Therefore, we believe that the protocols should be disseminated among Spanish ED physicians to increase their application in clinical practice.

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