The Journal of Nutrition, Health & Aging©
Volume 13, Number 5, 2009

VARYING INSULIN USE IN OLDER HOSPITALIZED PATIENTS WITH DIABETES

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Abstract: *Objective:* Observation of insulin use in consecutive hospitalized diabetic older patients in acute care wards with reference to nutritional intakes, measures of functional status, and varying clinical situations. *Methods:* Prospective case study in a geriatric medicine ward with CGA, dietary intake measure and used insulin dosage. *Results:* Among 600 inpatients, 90 diabetic subjects were found. Only 12.2 % diabetic patients had MMSE>23 and 23.3% were unable to eat without assistance. During the stay 54 patients had received insulin. From admission to discharge or death, doses were 0.39 to 0.19 U/kg (SD 0.41-0.15) during palliative care, 0.43 to 0.45 U/kg (SD 0.20-0.20) in the event of failure of oral therapy, 0.38 to 0.42 U/kg (SD 0.18-0.25) if creatinine clearance was 30 ml/min or lower, and 0.38 to 0.27 U/kg (SD 0.24-0.26) in critical diseases. Dietary intake increased in all during the stay with an energy intake close to 20 kCal/kg/d at discharge, except for those in palliative care, who had a final intake of 8.2 kCal/kg/d (SD 9.1). *Conclusion:* Insulin treatment guidelines adapted to this frail diabetic population are necessary.

Key words: Hospitalization, insulin treatment, frailty, dietary intake, comprehensive geriatric assessment, palliative care.

Introduction

Diabetes is one of the independent risk factors for hospitalization in community-living people aged 65-75yr (1) and also in those older than 75yr (2), probably resulting in a high frequency in hospitalized subjects. In acute-care geriatric wards, diabetes may be either the main cause of hospitalization or one of the co-morbidities. Doses of insulin in type 2 diabetes at any age seem to range from 0.4 to 0.6 U/kg/day (3,4). Hospitalized geriatric patients are likely to have different insulin needs owing to other indications for insulin therapy, to changes in dietary intake, to decreased creatinine clearance, to inflammatory states, or during palliative care. Furthermore, there is no specific guideline for glucose control target for this particular population. In palliative care, a frequent situation in these patients, it has been proposed to maintain blood glucose level between 10 and 20 mmol/l (5). Thus each practitioner is likely to work with a pragmatic approach (6). We have, therefore, described an elderly diabetic population in an acute-care ward in different clinical situations, with particular reference to palliative care and assessed their dietary intake and insulin doses used for them.

Methods

We prospectively observed in two 40-bed geriatric medicine acute care wards for an 8-month period all consecutive patients older than 70 yr, known to have type 2 diabetes, fasting blood glucose over 1.26 g/l or with blood glucose higher than 2g/l at any time. Other patients older than 70 yr were compared for their age, sex ratio, length of stay, in-hospital mortality and re-hospitalization rate at 3 months.

Treatment, HbA1c value in the 6 months before admission, if any, and HbA1c value at admission were described. Insulin therapy was reported in terms of doses in unit per kg body weight per day at admission, in the middle and the end of hospitalization. In this setting, fasting capillary blood glucose levels ranging from 1.20 g/l to 1.60 g/l and post-prandial from 1.60 g/l and 2.00g/l were considered satisfactory due to the frailty of subjects (7). However, no definite policies were available. The practice of the ward was to start insulin doses at 0.3 U/kg/d in subjects with potential alteration in food intake, 0.6 U/kg/d in those with obesity and 0.5 U/kg/d in the others. Insulin treatment indications were arbitrarily defined as follows: 1) patients with failure of long-standing oral therapy; 2) patients with a contra-indication of oral therapy due to creatinine clearance 30 ml/min or lower, including failure of long-standing oral therapy combined with contra-indications of oral treatment; 3) patients with a critical illness; 4) patients hospitalized for an illness necessitating palliative care from the beginning of their stay.

Diabetic patients were assessed for nutritional status with BMI determination and serum albumin dosages (normal range 35-45 g/l), and with dietary intake surveys. Dietary data were recorded throughout the stay and were analyzed as described previously (8) at the same time points as insulin dose assessment. Three-day records were used for each phase except when stays were shorter than 10 days (one-day records). Comprehensive geriatric assessment (CGA) was performed at admission. The Katz scale of activities of daily living (ADL)

Received December 27, 2007
Accepted for publication July 19, 2008

(9) was used to assess the current level of functional dependency with a total score of 0 for autonomy and 12 for full dependency. Delirium was sought and known dementia or diagnoses of depression were recorded. Current cognitive status was explored using the MMSE (Mini Mental State Examination) (10). Creatinine clearance was calculated using the Cockroft and Gault formula (11). C-reactive protein concentration (normal range < 5mg/l) was used to assess inflammatory status at admission. The occurrence of nosocomial infections defined according to CDC criteria (12) was also prospectively recorded.

Analysis

Numerical data were expressed as mean (SD) and quantitative data as proportions. Diabetic subjects were compared to other hospitalized patients using one-way ANOVA. Comparisons of diabetic patients in different insulin indication groups for insulin doses and nutritional status were done with one-way ANOVA and at different times of hospitalization using repeated measures analysis of variance models.

Results

Among 690 hospitalized subjects, 90 were diabetic (13.0 %) (Table 1). In-hospital mortality was 10.0 % in diabetic patients, and 13.8% in the others. Mean length of stay was longer in diabetic patients than in the others but three-month re-hospitalization rate was similar in both groups (20.0 % in diabetic patients versus 17.2 % in the others).

Diabetes and specific complications were the causes of hospitalization in 17.0 % of diabetic subjects. Diabetes was discovered at admission in 10 (11.1%) patients. HbA1c in the 6 months prior to hospitalization was found in only 36 subjects and was higher than 8.0 % in 13.2 % of them. Mean BMI was 25.1 kg/m2 (SD 4.2) and mean serum albumin was 32.0 g/l (SD 5.01). BMI over 30 was found in 10 subjects. Mean current HbA1c value was 7.7 % (SD 1.8) and was 6.5 % or lower in 25.6 % or 8 % of higher in 32.2%. Creatinine clearance was 30 ml/min or lower in 25.6 %.

CGA in diabetic patients indicated known dementia in 27.8 %, current delirium in 21.1 %, depression in 38.9 %, and ADL dependency in 91.1 % of them. In particular, 23.3 % were heavily dependent for eating. The mean ADL score was 6.4 (SD 4.0). MMSE was higher than 23 in 12.2 % of diabetic patients. Among those with MMSE 23 or lower, 43.8% were not known as demented, did not suffer from delirium and were not depressed, thus suggesting undiagnosed dementia. Nosocomial infections occurred in 20 diabetic patients and length of stay of patients with nosocomial infection was higher than in the others (respectively 41.3 (SD 21.7) versus 25.6 (SD 16.2), P=0.001).

In the 80 known diabetic patients, 3 were on diet alone, 44 were on oral therapy alone, 5 had insulin associated with oral therapy, and 28 were treated with insulin alone. In 23 patients among the 49 subjects receiving oral therapy, the latter was contra-indicated on the basis of a creatinine clearance 30 ml/min or lower. During the stay oral treatment was stopped in 26 patients, 8 remaining on diet alone, 5 on insulin alone and insulin was started in 17 patients, with a secondary discontinuation in 4. As a result, insulin was used in 54 (60.0%) diabetic patients during the hospitalization and was present at discharge or death in 49 (54.4%). During the stay, hypoglycemia was found in 20 patients but with symptoms only in two. All these subjects were on insulin therapy.

All insulin-treated diabetic patients were similar with regard to age, sex ratio, BMI, nutritional intake and insulin doses at the start of hospitalization (Table 2). Insulin doses were unrelated to MMS score, diagnosis of dementia or depression, ADL dependency, and delirium during stay at any time. At mid-stay and at discharge or death, insulin doses differed according to indications, with the lower doses being given in palliative care (Table 1). Energy and protein intake followed different courses according to indications (respectively P = 0.011 and P = 0.009), with a decrease in both only in palliative care. In the palliative care group, carbohydrates accounted for more than 50 % of energy intake during the stay.

Table 1

Comparison of diabetic and non diabetic patients for length of stay and in-hospital mortality

	Non diabetic patients N=600	**All diabetic patients N=90**	**Long-standing oral therapy failure and creatinine clearance > 30 ml/mn, N=18**	**Contraindication to oral treatment therapy due to creatinine clearance equal or < 30 ml/mn, N=17**	**Acute illness, N=13**	**Palliative care for life-threatening disease other than diabetes, N = 6**
Age (years) mean (SD)	83.2 (5.4)	85.4 (6.4)	83.9 (6.6)	84.9 (5.3)	83.8 (5.6)	81.7 (3.3)
Sex ratio (M/F)	0.50	0.49	0.50	0.31	0.86	0.50
Length of stay (days) mean (SD)	19.0 (14.2) *	29.1 (18.9)	31.8 (18)	23.0 (7.0)	37.2 (29.0)	39.3 (22.5)
In-hospital Death % of N	13.8	10.0	0	0	15.4	100

* comparison between diabetic and non-diabetic patients, p < 0.001 (one-way ANOVA)

Table 2
Diabetic patients characteristics in relation to insulin indications during hospitalization, N = 54 subjects

	Long-standing oral therapy failure and creatinine clearance > 30 ml/mn, N=18	**Contra-indication to oral treatment therapy due to creatinine clearance equal or < 30 ml/mn, N=17**	**Acute illness, N=13**	**Palliative care for life-threatening disease other than diabetes, N = 6**	**P***
Admission data: mean (SD)					
HbA1c (%)	9.2 (1.3)	7.5 (1.7)	8.6 (3.0)	8.9 (1.0)	0.138
Diabetes duration (years)	16.7 (10.4)	13.9 (12.4)	8.3 (7.4)	4.6 (4.5)	0.166
BMI (kg/m²)	25.5 (4.9)	25.1 (4.1)	25.3 (4.5)	24.7 (3.6)	0.984
Serum albumin (g/l)	34.0 (3.9)	30.2 (4.8)	31.7 (6.0)	25.5 (3.7)	0.003
C-reactive protein (mg/l)	15.9 (14.3)	31.5 (30.8)	91.9 (76.7)	99.9 (81.4)	<0.0001
Insulin doses (U/kg/d), mean (SD)					
At admission	0.43 (0.20)	0.38 (0.18)	0.38 (0.24)	0.39 (0.41)	0.934.
Mid-hospitalization	0.46 (0.23)	0.43 (0.25)	0.27 (0.27)	0.17 (0.13)	0.033
Discharge or death	0.45 (0.20)	0.42 (0.25)	0.27 (0.26)	0.19 (0.15)	0.057
Energy intake (kCal/kg/d), mean (SD)					
At admission	17.2 (7.5)	18.7 (7.2)	13.3 (5.1)	11.3 (3.4)	0.067
Mid-hospitalization	20.5 (4.3)	20.3 (7.7)	16.9 (5.0)	8.6 (6.8)	0.005
Discharge or death	21.1 (8.5)	20.7 (7.0)	17.4 (6.4)	8.2 (9.1)	0.021
Carbohydrate intake (g/kg/d), mean (SD)					
At admission	1.95 (0.99)	1.81 (0.46)	1.62 (0.70)	1.54 (0.42)	0.641
Mid-hospitalization	2.19 (0.52)	2.16 (0.77)	2.10 (0.57)	1.14 (0.88)	0.041
Discharge or death	2.35 (0.98)	2.21 (0.61)	2.26 (0.75)	1.13 (1.31)	0.101
Protein intake (g/kg/d), mean (SD)					
At admission	0.89 (0.42)	0.88 (0.24)	0.66 (0.29)	0.56 (0.22)	0.115
Mid-hospitalization	1.08 (0.27)	0.95 (0.37)	0.92 (0.42)	0.41 (0.34)	0.015
Discharge or death	1.06 (0.40)	0.98 (0.35)	0.85 (0.36)	0.38 (0.44)	0.019
Lipid intake (g/kg/d), mean (SD)					
At admission	0.64 (0.26)	0.64 (0.18)	0.45 (0.18)	0.42 (0.14)	0.052
Mid-hospitalization	0.83 (0.18)	0.68 (0.22)	0.60 (0.18)	0.27 (0.24)	<0.001
Discharge or death	0.83 (0.36)	0.70 (0.19)	0.63 (0.29)	0.24 (0.23)	0.008

P*, p values of one-way ANOVA comparisons of the four groups

Discussion

Subjects with diabetes observed in this study could be considered as frail owing to their high level of functional dependency, high rate of cognitive disorders and limited dietary intakes. We also observed a much greater length of stay and a higher rate of nosocomial infections in comparison with non-diabetic patients. In a previous study we estimated the rate of nosocomial infections in this setting to be 9.4 % (13). This high rate could therefore explain in part the difference in length of stay of these diabetic older patients and confirms that diabetes could be a frailty factor (14).

Due to the high rate of contraindication to oral therapy, the resulting use of insulin was high. Despite the low caloric intake the doses were in the lower range of those found in previously described out-patients (3, 4). The clinicians did not aim for accurate control, probably owing to the frailty of the patients, and we are not able to estimate the quality of control in the long term. The rate of hypoglycemia was probably underestimated, owing to the low rate of specific symptoms and to the high frequency of cognitive disorders. Patients' unawareness of hypoglycemia could be partly due to the frequent cognitive alterations in this population, alterations which have been found to prevent self-management in elderly diabetic out-patients (15).

Here we have attempted to differentiate the various clinical situations of insulin use that are encountered in diabetic hospitalized elderly patients. Doses of insulin tended to differ according to these situations but the sample size was too small to establish any recommendations.

Large-scale in-hospital studies are needed with the aim of proposing insulin schedules that optimize glycaemic control and at the same time reduce hypoglycaemia and other adverse effects.

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