Contents available at ScienceDirect
Diabetes Research and Clinical Practice
journal homepage: www.elsevier.com/locate/diabres
International Diabetes Federation

The prognostic significance of admission blood glucose levels in patients with urinary tract infection

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ARTICLE INFO

Article history:
Received 14 June 2015
Received in revised form
11 January 2016
Accepted 17 January 2016
Available online xxx

Keywords:
Glucose
Diabetes mellitus
Urinary tract infection
Admission

ABSTRACT

Aims: Evaluate the association between admission blood glucose (ABG) and short and long-term outcomes following hospitalization for urinary tract infection (UTI).

Methods: Single center, retrospective cohort study of patients admitted to medical wards between January 1, 2011 and December 31, 2013 with a diagnosis of UTI. Patients were classified to those with diabetes mellitus (DM) and those without it. ABG levels were classified to categories: ≤70, 70–110, 111–199, ≥200 mg/dl. Primary outcome was all-cause mortality within 30-days and 1-year. Secondary outcomes were hospital readmissions within 30-days and 1-year, and survival rates at end of follow-up.

Results: Cohort included 3405 patients (median age, 78 years; 44% men), 1106 with DM and 2299 without it. Among patients without DM, compared with ABG between 70 and 110 mg/dl ($n = 852$, 37%), there was a significant association between ABG and all-cause mortality: hazard ratios (95% CI) with ABG ≤70 mg/dl ($n = 13$, 0.6%), 111–199 mg/dl ($n = 1292$, 56%), and ≥200 mg/dl ($n = 142$, 6%) were: 3.67 (0.89–15.14, $p = 0.07$, 23% mortality ($n = 3$)), 1.85 (1.29–2.64, $p < 0.001$, 7% mortality ($n = 89$)), and 2.94 (1.71–5.07, $p < 0.0001$, 11% mortality ($n = 15$)) at 30-days, and 3.8 (1.87–7.71, 38% mortality ($n = 5$)), 1.35 (1 1.13–1.60, 7% mortality ($n = 215$)), and 2.02 (1.50–2.71, 25% mortality ($n = 35$)) at 1-year (all $p < 0.001$). In patients with DM there was no significant association between ABG and mortality. There was no association between ABG and readmissions in both groups.

Conclusion: There is a significant association between ABG and short and long-term, all-cause mortality in patients without DM, but not in patients with DM, hospitalized for UTI.

1. Introduction

Diabetes mellitus (DM) is associated with an increased risk of morbidity and mortality caused by infectious diseases, probably due to abnormalities of host response, mainly in neutrophil chemotaxis, adhesion and intracellular killing [1–5]. Elevated admission blood glucose (ABG) levels during acute illness is common and is associated with poor outcomes among patients with and without diabetes following admission for several conditions: ischemic or hemorrhagic stroke [6], surgery [7], trauma [8], heart failure [9,10], pneumonia [11–13], pulmonary embolism [14] and acute myocardial infarction [15–17].

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http://dx.doi.org/10.1016/j.diabres.2016.01.025
0168-8227/

Urinary tract infection (UTI) is one of the most frequent infections among hospitalized patients with diabetes mellitus. There are conflicting reports regarding the risk of UTI associated with diabetes duration, HbA1c levels, and complications [2,18,19]. Nevertheless, the risk for recurrent UTI is higher among patients with DM, compared with ones without DM [20,21].

Blood glucose levels on admission are readily available for most hospitalized patients, and might predict the short and long-term outcomes of patients admitted for UTI. Therefore, in this study we aimed to evaluate the association between ABG levels in patients with and without DM and all-cause short and long-term outcomes following hospitalization for UTI.

2. Methods

Retrospective observational data were extracted from the electronic medical records of all patients who were admitted to the medical wards in Rabin Medical Center, Israel, between January 1, 2011 and December 31, 2013. Inclusion criteria were age ≥18 years with a principal discharge diagnosis of UTI. In case of a recurrent admission, the initial one with a diagnosis of UTI was considered the index hospitalization. Patients for whom 30-days or 1-year readmission and mortality information were not available, as well as ones without a documented ABG levels, were excluded.

Rabin Medical Center, encompassing Beilinson and Golda-Hasharon campuses, is a tertiary-care facility with more than 1300 beds. Most of the admissions to the 10 medical wards are through the emergency department, and all patients' data are recorded in electronic medical charts, based on the same database platform used in community primary care facilities. Mortality data were obtained from the hospital's mortality database, updated from the Ministry of the Interior Population Registry. We collected mortality data until February 1, 2015.

Patients were stratified into those with pre-existing DM, if their medical record included the diagnosis of DM or the use of any oral hypoglycemic agent or insulin at the time of admission, and to those without DM. UTI was defined as symptomatic cystitis (lower UTI) and pyelonephritis (upper UTI or infection of the kidney), in both men and women, based on clinical presentation and the presence of positive urine culture.

ABG levels, defined as the blood glucose level closest to the patient arrival time, within the first 24 h of the admission date, were classified into the following categories: ≤70, >70–110, >110–199, ≥200 mg/dl.

Other collected data were regarding co-morbidities, as defined in the medical records, including: malignancy, ischemic heart disease, chronic heart failure, hypertension, chronic renal failure, chronic obstructive pulmonary disease, asthma, hypothyroidism or hyperthyroidism and inflammatory bowel disease.

The primary outcome was the rate of all-cause mortality within 30 days and 1 year after the index admission. We have also evaluated survival at end of follow-up. Secondary outcomes were the association of ABG with hospital readmissions within 30-days and 1-year, based on the medical records in our hospital.

2.1. Statistical analysis

The statistical analysis was generated using SAS Software, version 9.4 of the SAS System for PC, Copyright 2002–2012. SAS Institute Inc. and all other SAS Institute Inc. products or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.

Continuous variables were presented by mean ± SD, categorical variables were presented by (*n*, %). *T*-test was used to compare the value of continuous variables between study groups and Chi-Square was used to value of categorical variables between study groups. Cox proportional hazards model was used to assess the effect of study variables on survival, including gender, corticosteroid treatment, ischemic heart disease, congestive heart failure, hypertension, cerebrovascular disease and chronic obstructive pulmonary disease, as well as for interaction between DM and glucose levels. Since this interaction was significant ($p < 0.15$), the Cox model was rerun by DM groups. Age was not included in the analysis due to strong intercorrelations and multicollinearity with age, ABG and DM. Cox proportional hazard and Fine and Gray's competing risk model was used to evaluate the interaction between ABG, readmissions and mortality.

We had complete data for all the study variables, other than BMI and smoking. No imputation for missing data was done because missing at random cannot be assumed.

3. Results

3.1. Study cohort

Amongst 73,796 admissions to the medical wards during the study period, the final cohort composed of 3405 patients with complete data (Fig. 1). Median age of the cohort was 78 years (18–114 years), 1500 were men (44%) and 2299 (68%) did not have pre-existing DM. Compared with the patients with DM, those without it were younger (mean age 77 ± 11 vs. 71 ± 20, $p < 0.001$), with lower BMI (27.2 vs. 25.6, $p < 0.001$). Furthermore, rates of hypertension, hyperlipidemia, ischemic heart disease, congestive heart failure, chronic renal failure and cerebrovascular disease were significantly higher in the group of patients with pre-existing DM (Table 1).

Median ABG levels were 179 mg/dl (32–887) and 119 mg/dl (44–752), respectively. Most ABG levels in both patients with and without DM were between 111 and 199 mg/dl (49% and 56%, respectively). ABG levels of ≥200 mg/dl were documented in 435 (39%) patients with pre-existing DM and 142 (6%) patients without DM.

Data regarding mortality and readmission at 30-days and 1-year, according to ABG levels and DM status is provided in Table 2.

3.2. Admission blood glucose and mortality

3.2.1. Patients without DM

In patients without DM, there was a statistically significant association between ABG levels and all-cause mortality at 30-days and 1-year. 30-Days mortality rates in patients without DM and ABG levels ≤70 mg/dl, 70–110 mg/dl, 111–199 mg/dl,

Please cite this article in press as: Akirov A, Elis A. The prognostic significance of admission blood glucose levels in patients with urinary tract infection. Diabetes Res Clin Pract (2016), http://dx.doi.org/10.1016/j.diabres.2016.01.025