Available online at www.sciencedirect.com
ScienceDirect
journal homepage: http://www.elsevier.com/locate/medici

Original Research Article

Relationship between diabetes mellitus and heart rate variability in community-dwelling elders

Ícaro J.S. Ribeiro [a,b,*], Rafael Pereira [b,c], Paulo F. Valença Neto [d], Ivna V. Freire [a], Cezar A. Casotti [b,e], Mitermayer Galvão dos Reis [a]

[a] Biotechnology in Health and Investigative Medicine Postgraduate Program, Gonçalo Moniz Research Center, Candeal – Salvador, BA, Brazil
[b] Nursing & Health Postgraduate Program, State University of Southwest Bahia (UESB), Jequie, BA, Brazil
[c] Department of Biological Sciences, State University of Southwest Bahia (UESB), Jequie, BA, Brazil
[d] Collective Health Institute, Federal University of Bahia, Canela, Salvador, Brazil
[e] Health Department, State University of Southwest Bahia (UESB), Jequie, BA, Brazil

ARTICLE INFO

Article history:
Received 13 July 2016
Received in revised form
25 November 2017
Accepted 14 December 2017
Available online xxx

Keywords:
Autonomic nervous system
Heart rate
Cardiac electrophysiology
Diabetes mellitus

ABSTRACT

Background and objective: Diabetes mellitus is one of the most common non-communicable diseases (NCDs) and may influence the autonomic nervous system. This study aims to analyze the autonomic control, through heart rate variability (HRV), from community-dwelling elders with (DM+) and without diabetes mellitus (DM−).

Materials and methods: This cross-sectional study, in which 205 elders (≥ 60 years old), from the urban area of Aiquara municipality gave their written consent to participate. HRV data was collected through a Polar RS800CX monitor with a 5-min initial record at rest, followed by the command to quickly stand up.

Results: The mean age was 71 years (SD, 7.32). The population was mostly made up of women 121 (59%), with low or no schooling 123 (60%), and low income 166 (81%). HRV analysis in a frequency domain showed no difference when comparing the two groups of DM + and DM−. Henceforth in a time domain, the rMSSD showed a median value of 16.09 (interquartile range, 9.91–30.68); pNN50 median of 0.79 (interquartile range, 0.00–6.62), with a statistical significance between the group of DM+ and DM−.

Conclusions: There is a difference between the studied groups principally in what concerns the time domain, which reflects the parasympathetic activity, suggesting that elders with diabetes mellitus may have a worse parasympathetic control.

* *Corresponding author at*: Nursing & Health Postgraduate Program, State University of Southwest Bahia (UESB), 45200-000 Jequie, BA, Brazil.
E-mail address: icaro.ribeiro29@gmail.com (Ícaro J.S. Ribeiro).

https://doi.org/10.1016/j.medici.2017.12.001

Please cite this article in press as: Ribeiro ÍJS, et al. Relationship between diabetes mellitus and heart rate variability in community-dwelling elders. Medicina (2018), https://doi.org/10.1016/j.medici.2017.12.001

1. Introduction

Non-communicable diseases (NCDs) have increased in recent decades, owing to changes in demographic profile, characterized by an increase in the elderly population [1,2]. Diabetes mellitus is one of the most common NCDs and, as well as the aging process, may influence the autonomic nervous system (ANS), leading to a poor autonomic control of heart [3,4].

The aging process brings a natural degeneration of the ANS. This has a direct impact on the autonomic function that has been observed in a number of different ways [5]. Some changes that may occur in ANS during aging include loss of neurons, loss of axon branches and alterations in neurotransmitters and other intra-cellular features [6,7]. Clinically, these events lead to a decline of the parasympathetic control of the heart with normal aging [8], and aging associated with NCDs, e.g., diabetes mellitus, may substantially impair the parasympathetic cardioprotection.

Autonomic dysfunction has been linked with a wide range of diabetic complications [9], and the early detection of subclinical autonomic disabilities through heart rate variability (HRV) analysis in people with diabetes mellitus may be important for risk stratification and subsequent therapeutic management, including pharmacological and lifestyle interventions [10,11]. Thus, we aimed to analyze the autonomic control, through heart rate variability, in community-dwelling elders with and without diabetes mellitus.

2. Materials and methods

A total of 205 elders (≥60-years-old) [12] from the urban area of Aiquara municipality gave their written informed consent to participate in the study. Aiquara is located in the central south region of Bahia, approximately 402 km from the state capital, with 4602 inhabitants, a Gini index of 0.5376, and a HDI value of 0.583 [13]. Elders were visited door to door and interviewed by trained interviewers; then, they were scheduled to attend the municipal hospital for carrying out the examinations. All procedures were approved by the local ethics committee according to the Declaration of Helsinki (#135\2008).

One week after the inclusion visit, the subjects reported to the hospital. The subjects were asked to abstain from smoking, alcoholic beverages, or caffeine-derived products 24 h before the data collection. Before resting for 10 min in an acclimatized and quiet room, the skin of the subject was cleaned and prepared for the attachment of the heart rate monitor (HRM) elastic electrode belt (RS800XC, Polar) [14]. The electrode belt was placed just below the chest muscles, using the xiphoid process as a reference. The procedures of data collection and analyses were according to the Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology [15].

After explaining the procedures and placement of the HRM, the elders were placed on a hammock in the supine position. After 5 min of resting the record was started. A 5-min record [15] was conducted on all subjects. Analyses of HRV were performed in time and frequency domain according to methods following previous recommendations [15]. For time domain analysis two parameters were used: the square root of the sum of the square of the differences between the R-R (rMSSD), an indirect measure of the parasympathetic activity, and the percentage of the total number of R-R that has a difference of more than 50 ms relative to the previous R-R (pNN50), both used as indirect measures of parasympathetic tone. Frequency domain analysis was carried out to determine the spectral power density, which was decomposed in a low frequency (LF) band (0.04–0.15 Hz) and a high frequency (HF) band (0.15–0.4 Hz). Normalized spectral power of the LF and HF bands (i.e., the power of these bands divided by the total spectrum power), as well as, the LF/HF ratio were used for statistical analysis [15–17].

Additionally, a lying-to-standing test was performed following recommendations from Ewing et al. [18]. After 5 min of bed rest, the subjects stood up as quickly as possible and remained standing for 2 min. The 30:15 ratio (i.e., the ratio of the longest R-R interval around the 30th beat to the shortest R-R interval around the 15th beat after posture change) was calculated as recommended by Ewing et al. [18]. This index (i.e., 30:15 ratio) reflects the activity of both parasympathetic and sympathetic autonomic nervous system activity, but, differently from other HRV-studied parameters, the 30:15 ratio reflects the parasympathetic modulation of the heart during a dynamic condition [18]. The studied population was stratified according to the results from the 30:15 ratio. For analysis, the criteria proposed by Boer et al. [19], which classifies the subjects as normal (≥1.01) and abnormal (≤1.00), was considered. The normality of the data distribution was verified by using the Kolmogorov–Smirnov test, and as the data were not normally distributed, the median and interquartile range of the studied variables were computed for the total population.

The indices obtained by time (rMSSD, pNN50) and frequency (LF, HF, LF/HF) domain from person with (DM+) and without (DM−) diabetes mellitus were compared using the Mann-Whitey test. The chi-square (χ^2) test was applied to compare the proportions between groups DM+ and DM−) for the autonomic test outcomes (i.e., normal or abnormal response of 30:15 ratio). A significance level of $P < 0.05$ was used with all statistical procedures. Statistical analysis was completed using SPSS 21.0 (SPSS Inc., Chicago, IL).

3. Results

During the period from February to April 2013, a total of 205 individuals were interviewed and examined, including 37 DM+ (13 men aged 71.62 [SD, 7.27] years and 24 women aged 70.25 [SD, 6.66] years) and 168 DM− (71 men aged 72.25 [SD, 8.24] years and 97 women aged 71 [SD, 6.79] years (Table 1).

Table 1 – Characteristics of studied elders from Aiquara-BA, Brazil.

		n	%
Sex	Female	120	58.5
Race/color	Non White	170	82.9
Diabetes mellitus	Present	37	18.0
Hypertension	Present	141	68.8
Family income	≤1 Salary	166	81.0
Smoking habit	Absent	114	55.6

Please cite this article in press as: Ribeiro ÍJS, et al. Relationship between diabetes mellitus and heart rate variability in community-dwelling elders. Medicina (2018), https://doi.org/10.1016/j.medici.2017.12.001