ELSEVIER

International Journal of Cardiology 105 (2005) 152–158

International Journal of Cardiology

www.elsevier.com/locate/ijcard

Influence of age, gender, and serum triglycerides on heart rate in a cohort of asymptomatic individuals without heart disease

Rogério Silva de Paula*, Ivana Antelmi, Marcos Antonio Vincenzi, Carmen D.S. André, Rinaldo Artes, Cesar José Grupi, Alfredo José Mansur

Heart Institute (InCor), University of São Paulo Medical School, General Outpatient Clinics, Av. Dr. Enéas de Carvalho Aguiar, 44, São Paulo, 05403-000, Brazil

Received 23 August 2004; accepted 13 November 2004
Available online 12 March 2005

Abstract

Background: Age, sex and blood lipids were demonstrated in epidemiological studies to influence heart rate measured on physical examination, on 12-lead electrocardiogram or with automatic devices for short-term measurements. We hypothesized that in healthy individuals, age, sex and other clinical variables may also influence heart rate measured on 24-h ambulatory electrocardiographic monitoring.
Methods: We studied 625 asymptomatic individuals with normal clinical examination, aged 15 to 83 (mean 42, standard deviation 11.9) years, 276 (44.2%) men and 349 (55.8%) women. Heart rate was evaluated on 24 h ambulatory electrocardiographic monitoring. Variables selected in univariate analysis (χ^2 and Student t tests) were further submitted to multivariate analysis with canonical correlation to assess the strength of associations between heart rate and other variables, and multiple linear regression models to generate reference curves.
Results: Age was the most significant influence on canonical variable of heart rate relative to other clinical and laboratory variables (0.55; $p<0.01$). There was an increase in the minimum heart rate and a decrease of maximum heart rate with increasing age in both genders. The increase was steeper in men and the decrease was steeper in women. Minimum heart rate increased with increasing serum triglycerides and decreased as estimated maximum oxygen consumption increased.
Conclusions: There was a narrower variation of heart rate with increasing age in both genders in healthy individuals. This variation was less pronounced in women. In addition, status of body haemostasis associated with peculiar metabolic conditions expressed in serum triglycerides levels may also be associated with heart rate.

Keywords: Heart rate; Ambulatory electrocardiographic monitoring; Ambulatory care; Preventive health service

Epidemiological and clinical studies demonstrated that heart rate was an independent variable associated with cardiovascular mortality. Heart rate was evaluated either through pulse rate on physical examination [1,2], 12-lead electrocardiogram [3–6], short-term monitoring [7], or 24 h ambulatory electrocardiographic monitoring [8,9]. Heart rate was also demonstrated to be modulated by age [10–12] and gender [12,13]. In addition, metabolic variables such as cholesterolemia and serum triglycerides [7] were also demonstrated to be related to heart rate [14].

Studies of heart rate with ambulatory electrocardiographic monitoring in healthy individuals relative to age and gender were performed in smaller samples, in the range between 37 and 191 participants [10,11,15–18], in restricted population strata [10,12,19–27] with different recording methods [15,19,28,29]. Higher resting heart rate was also demonstrated to be associated with increasing age and increasing blood pressure [14].

Studies of heart rate in healthy individuals may contribute to the knowledge of the heart rate as a variable related to

* Corresponding author. Tel.: +55 11 3069 5237; fax: +55 11 5521 8749.
E-mail address: casrspaula@incor.usp.br (R.S. de Paula).

0167-5273/$ - see front matter © 2005 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.ijcard.2004.11.023

cardiovascular health. We performed a large cohort study of asymptomatic outpatients submitted to careful clinical and laboratory work-up to assess heart rate relative to age, gender and other clinical and laboratory variables.

1. Methods

1.1. Study protocol

A cohort of asymptomatic individuals with no evidence of heart disease after careful clinical examination was established to evaluate heart rate on 24-h ambulatory electrocardiographic monitoring relative to other clinical and laboratory variables, from April 1997 to October 2001. This cohort was established in a large General Outpatient Clinics from a tertiary care university hospital, dedicated to cardiology that provides also primary and secondary levels of care. Several Individuals looking for hospital to check-up in the absence of symptoms and this was a mainly stratus utilize to characterize the population of this study.

The clinical evaluation included detailed medical examination, electrocardiogram and chest X-ray. The asymptomatic individuals with normal clinical examination, as well as normal electrocardiogram and chest X-ray, were considered eligible for the study, and were invited to participate. After informed and written consent, participants were submitted to further laboratory work-up, including treadmill electrocardiographic exercise stress test and doppler two-dimensional transthoracic echocardiography. In addition, laboratory work-up included haemoglobin, hematocrit, leukocyte count, serum glucose, total and partial cholesterol, triglycerides, uric acid, thyroid-stimulating hormone, creatinine, and urinanalysis.

1.2. Inclusion criteria

We included in the study asymptomatic Brazilian men and women, older than 15 years of age, asymptomatic and with normal clinical examination, as well as normal electrocardiogram and chest X-ray.

1.3. Exclusion criteria

We excluded symptomatic patients, as well as patients with past medical history of cardiovascular disease, systemic hypertension, *Trypanosoma cruzi* infection (Chagas' disease microorganism), diabetes mellitus, thyroid-stimulating hormone lower than 0.05 or higher than 8 mg/dL, chronic obstructive pulmonary disease, asthma, renal failure, chronic inflammatory diseases, osteoarticular diseases, chronic anemia or neoplasia, abnormal 12-lead resting electrocardiogram, echocardiogram or treadmill electrocardiographic exercise stress test.

1.4. Study sample

Six hundred and twenty-five individuals were enrolled in the study, 276 (44.2%) men and 349 (55.8%) women. The ages ranged between 15 and 83 (mean 42, standard deviation 11.9) years. Hundred four (16.6%) individuals were aged between 15 and 30 years; 501 (80.2%) between 31 and 64 years; and 20 (3.2%) were 65 years old or older. Clinical and laboratory characteristics of the study sample are presented in Table 1. One hundred twenty-six (20.2%)

Table 1
Clinical and laboratory variables

Variables	Mean	Median	Minimum	Maximum	Standard deviation
Clinical variables					
Age (years)	42	42	15	83	11.9
Body mass index (kg/m^2)	26.2	25.95	14.9	44	4.3
Systolic blood pressure (mm Hg)	123.2	120	80	160	11.1
Diastolic blood pressure (mm Hg)	78.4	80	60	110	7.1
Laboratory variables					
Total cholesterol (mg/dl)	194	190	98	328	38.5
HDL-cholesterol (mg/dl)	51.5	46	20	267	28.5
LDL-cholesterol (mg/dl)	121.4	119	0	227	36.3
Triglycerides (mg/dl)	118.8	96	24	929	85.5
TSH (micro UI/dl)	1.8	1.65	0.2	5.3	1
Resting heart rate (bpm)	79.2	78	46	133	13
Exercise stress test heart rate (bpm)	166.8	170	110	209	21.4
Exercise stress test duration (min)	7.5	7.5	1.75	15	1.9
Maximum oxygen consumption (ml/kg/min)	39.6	41.7	14.1	75.3	9.9
Ambulatory electrocardiogaphic monitoring (24 h)					
Minimum heart rate	48.8	49	28	80	7.2
Maximum heart rate	136.4	135	97	189	16.8
Mean heart rate	77.4	77	50	107	8.7