Analysis of the Heart Rate Variability and Stratification of the Risk of Cardiac Patients with Chagas' Disease

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Abstract

According to the World wide Organization of the Health[1], the number of people infected with the **Tripanosoma Cruzi** *is considered between 16 and 18 million, causal agent of the Chagas' disease, and in 100 million the people exposed to the affectation risk. When concluding in 1983 a study longitudinal epidemiologist in patients with the disease evaluated [2, 3] every 3 years, the cardiac affectation: chronic Chagasic myocarditis (MCHC) increased from a 17% at the beginning of the study to a 49, 4% after 15 years. Previous studies of the variability of cardiac frequency in patients with the Chagas' disease[4, 5], show alterations in the spectral indices of the HRV. We analyze the 24-hour heart rate by Holter recordings in 62 patients with ECG alterations (CH2), 32 patients without ECG alterations (CH1) who had positive serological findings for disease of Chagas' and 36 healthy subjects (Control) matched for sex and age.*
We find a orthogonal base that is able to discriminate the groups from circadian profiles, Control and CH2, and stratify the groups CH1.

1. Introduction

The study of heart rate variability (HRV) evaluates the interaction between the two branches of the autonomic nervous system (Sympathetic and Parasympathetic) on the heart rate and thus measures the integrity of the autonomic nervous system and baroreceptor reflex. The HRV shown be a great risk factor and predictor of events in patients with heart disease, especially in terms of new events and the occurrence of death from all causes and cardiac arrhytmic death. The HRV was evaluated both in the time domain and in the frequency domain. More recently had been implemented with favorable results, analysis with non-linear modeling techniques that have enabled the detection of abnormalities early in the HRV. In this paper, we will use the methods of the time domain and frequency domain of HRV .

2. Data base and registry

We used the data base (*H*olter) of the **Instituto de Medicia Tropica IMT, UCV**. First evaluation (first cut) between 1998-1999, second evaluation (second cuts) between 2000-2002. The population this composing by two groups:

- Group A (control) constituted by 36 volunteers healthy (15 m 21 f), with an age average of $37,4$ years;
- Group C (CH2) constituted by 62 patients with ECG alterations (CH2) had positive serological findings for disease of Chagas' (37 m and 25 f), with an age average of $44,8$ years.

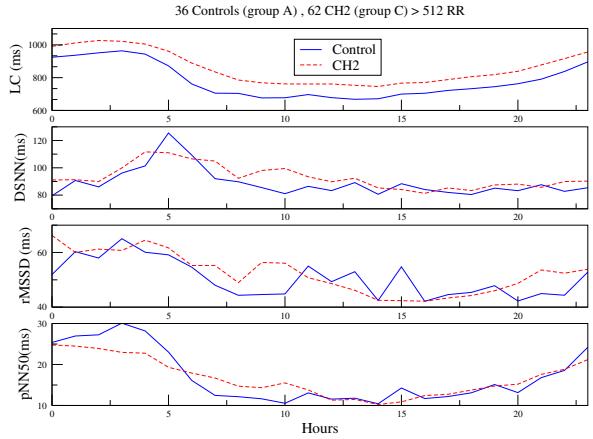
To all of them the following tests was practiced:

- Clinical evaluation
- Test Machado-Gerreiro (immunological test that detects the presence of antibody of the *T. cruzi*)
- X-ray of thorax
- Echocardiogram
- Electrocardiogram of average signals
- Test of effort
- Protocol of Bruce
- Standard electrocardiogram of 12 derivations
- Dynamic electrocardiography of 24 hours *Holter*.

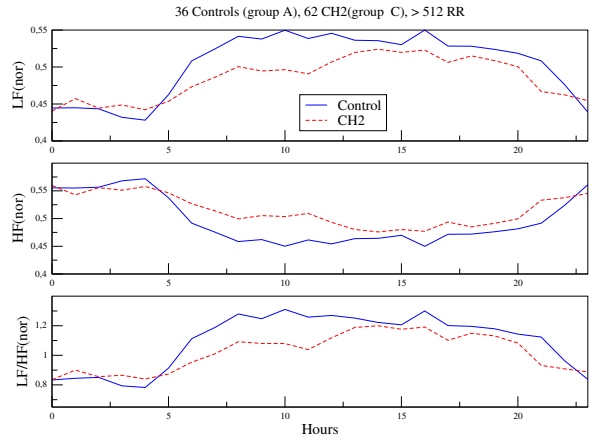
We analyzed the 24-hour heart rate by Holter recordings in Group A and C.

3. Circadian profiles (time domain)

The indices of the statistical *HRV* that we will use are: *LC*, *SDNN*, *pNN50*, *rMSSD*, and frecuenciales *LF*, *HF*, *LF/HF*



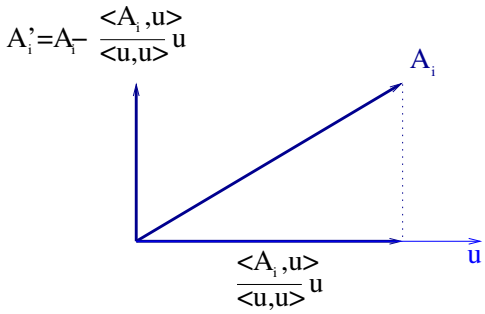
4. Circadian profiles (frequency domain)

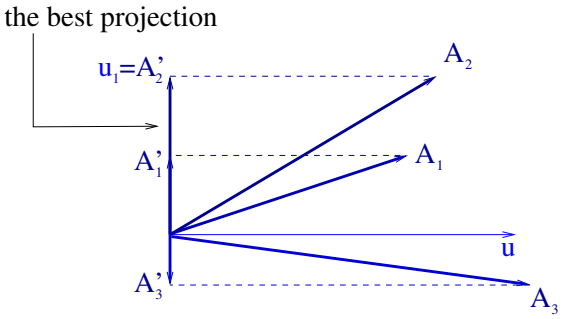


We constructed with each circadian profile and indices a vector of 24 components:
$A_1 = (1.12, 1.13, 1.07, ..., 0.90, 1.07, 1.09)$,
Then we looked for a sub space of vectors of the group A or the region where they coexist. Hence we constructed an orthogonal base (special Gram-Schmidt)

5. Construction of the orthogonal base

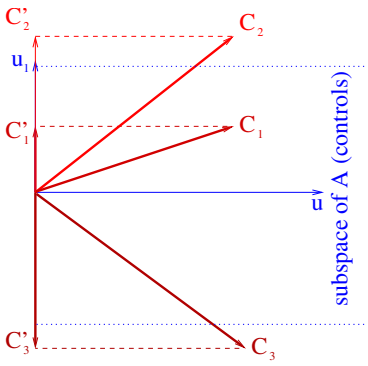
The first vector bases u is the value average of profiles circadian (by each index), the second vector base u_1 is the greater orthogonal projection, the other vector bases are constructed similarly



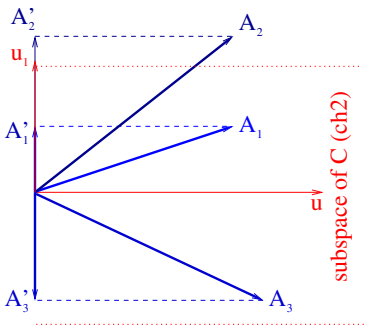


5.1. Orthogonal projection

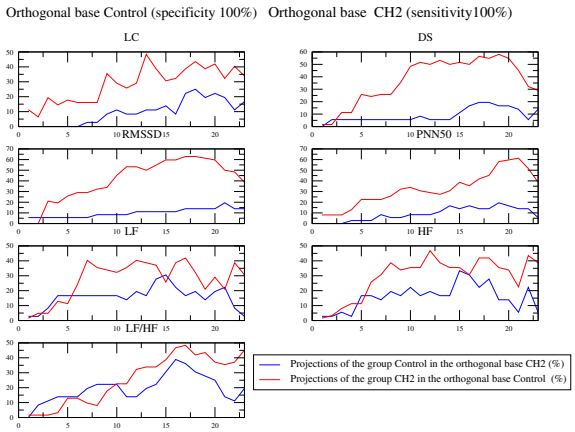
The constructed base contains to all the vector of group A (sub space of the group controls). Hence we looked for the orthogonal projections of vector of group C ($CH2$) in this base

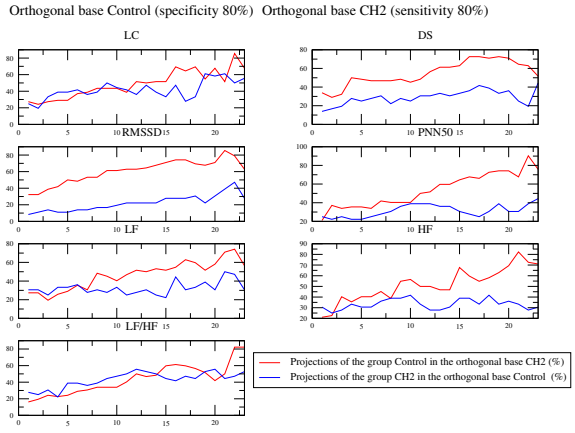


Hence we constructed an orthogonal base with the vector of group C (CH2) and we looked for the orthogonal projections of the group A (control)



6. Projections - circadian profiles





7. Results

- We found that the group A (control) the sub space of the vector of the circadian profile is within than the sub space of the vector of the circadian profile of the group C (CH2)
- It was found that the C group (CH2) in the indices rMSSD and pNN50 has a sensitivity more than of 60% for an specificity of the group C (control) of the 100%
- We found that the C group (CH2) in all the indices has a sensitivity more than of 72% for an specificity of the group C (control) of 80%
- With these results we hoped to stratify the risk in the B group (CH1) patients without ECG alterations.

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