The MUSIC Database: Sudden Cardiac Death in Heart Failure Patients

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[Preview]: MUSIC (Sudden Cardiac Death in Chronic Heart Failure)

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Abstract

The MUSIC (MUerte Subita en Insuficiencia Cardiaca) study is a prospective, multicentre, longitudinal study designed to assess risk predictors of cardiac mortality and sudden cardiac death (SCD) in ambulatory patients with chronic heart failure (CHF).

The study population consisted of 992 patients with CHF consecutively enrolled from the specialized HF clinics of eight University Spanish Hospitals between April 2003 and December 2004, and followed up for a median of 44 months (until November 2008). All patients had a 12-lead electrocardiogram (ECG), a 24 h, 2-(4%) or 3-lead (96%) Holter ECG, chest X-ray, echocardiography, and blood laboratory parameters performed at enrolment.

Primary outcomes were cardiac death, either sudden cardiac death (SCD) or pump failure death (PFD) at the end of the follow-up period.

Background

The MUSIC (MUerte Subita en Insuficiencia Cardiaca) study, is a prospective, multicentre, longitudinal study designed to assess risk predictors of cardiac mortality and sudden cardiac death (SCD) in ambulatory patients with chronic heart failure (CHF) [1,2].

The study population consisted of 992 patients with CHF consecutively enrolled from the specialized heart failure clinics of eight University Spanish Hospitals between April 2003 and December 2004, and followed up a median of 44 months (or upon November 2008). All patients had a 12-lead ECG, 24 h, 2-(4%) or 3-lead (96%) Holter ECG, chest X-ray, echocardiography, and blood laboratory parameters performed at enrolment. Primary outcomes were cardiac death, either sudden cardiac death (SCD) or

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DOI (version 1.0.0):
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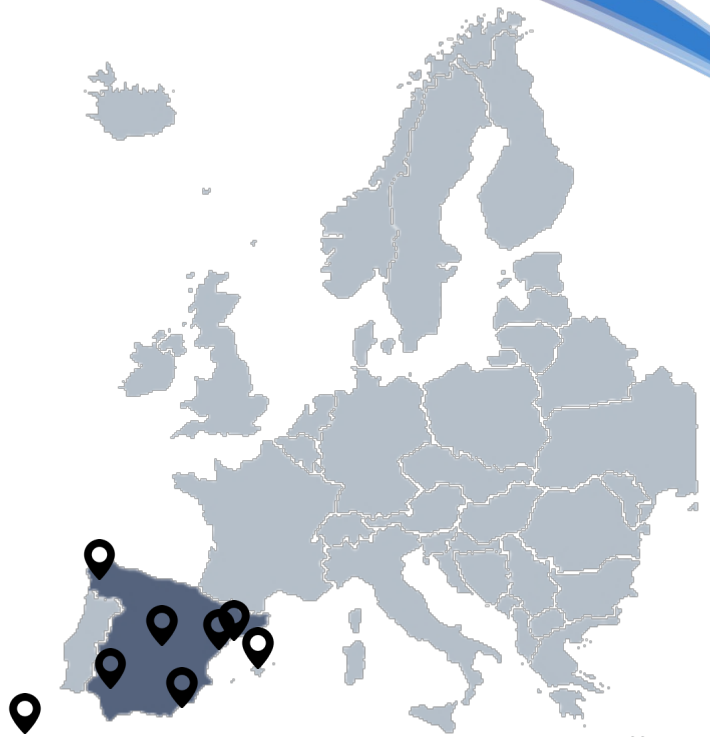
PhysioNet
the research resource for complex physiologic signals

The database is accepted to be available to the scientific community on **PhysioNet** resource

The MUSIC study

- "*MUerte Súbita en Insuficiencia Cardiaca*"- Sudden Cardiac Death in Heart Failure
- a multicenter, prospective and longitudinal study conducted by the specialized heart failure (HF) clinics from **eight** Spanish University **Hospitals**



AIM

design of **prognostic models** for cardiac and sudden cardiac mortality in ambulatory chronic HF patients

Study design

- **Consecutive patients** with symptomatic CHF corresponding to New York Heart Association (**NYHA**) classes **II and III** (mild to moderate).
  - Depressed LVEF (<45%)
  - Preserved LVEF (≥45%) + HF symptoms/hospitalization or objective signs of HF (X-ray or echo)
- **Exclusion criteria:**
  - Recent acute coronary syndrome
  - Severe valvular disease
  - Other concomitant diseases expected to reduce life-expectancy
- **Endpoints: Cardiac death**
  - Pump failure death (PFD): death occurring in a hospital as a result of refractory progressive end-stage heart failure
  - Sudden cardiac death (SCD): (i) a witnessed death occurring within 60 min from the onset of new symptoms unless a cause other than cardiac was obvious; (ii) an unwitnessed death (<24h) in the absence of preexisting progressive circulatory failure or other causes of death; or (iii) a death during attempted resuscitation.

Data acquisition

- **992 consecutive CHF patients**
- **Enrollment and data collection:** from April 2003 to December 2004.
- **Clinical tests** at enrollment:
  - 24-hour, 3-lead Holter ECG (SpiderView records, Sorin Group, fs=200 Hz, n=936)
  - high-resolution, 3-lead 20-min ECG (fs=1000 Hz, n=687)
  - chest X-ray
  - echocardiography
  - blood laboratory parameters
- Medications, demographic and clinical characteristics
- **Follow-up**: every 6 months, for 4 years (median of 44 months)

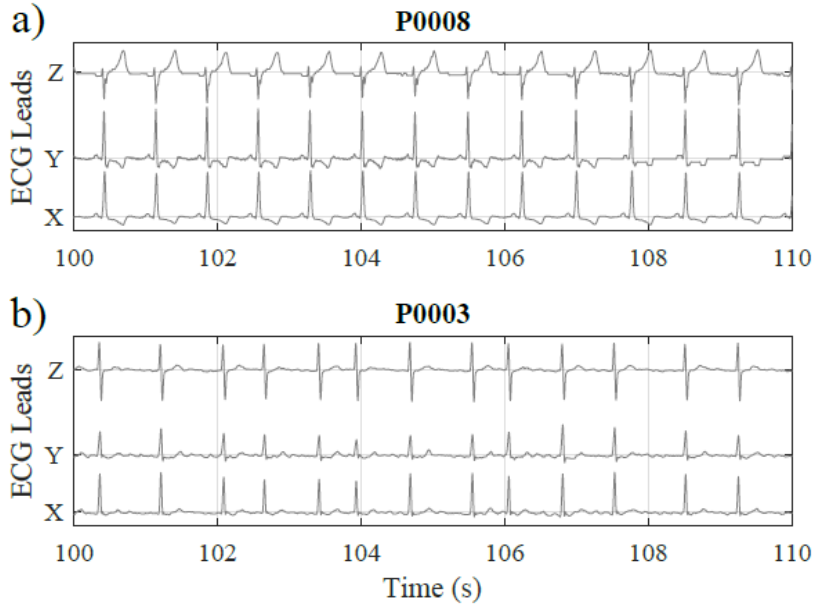


Figure 1: Example of two 10-s traces from ECG Holters. Orthogonal leads X, Y and Z from a patient in a) sinus rhythm, and b) permanent atrial fibrillation.

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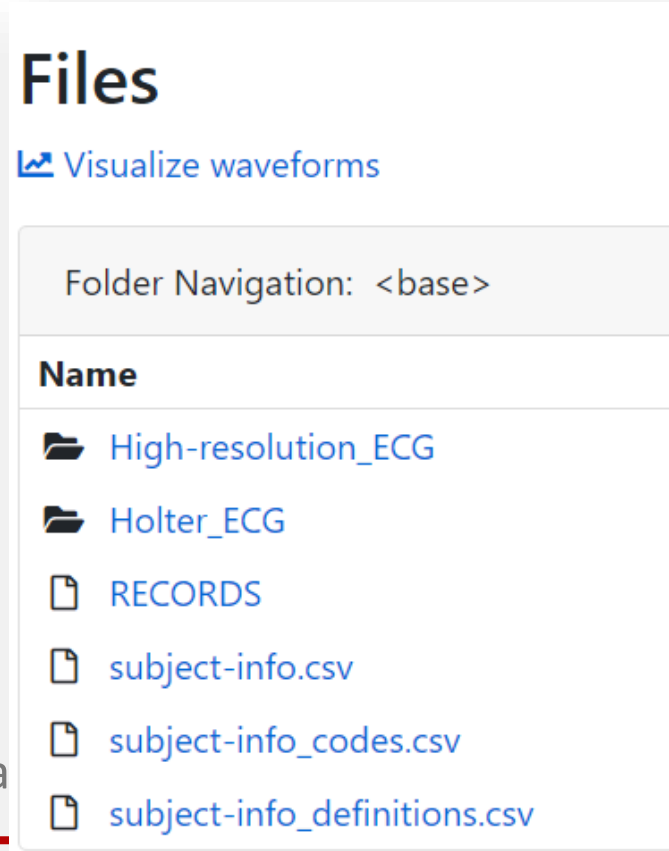
Data files

- *subject-info.csv:* list of variables
- *subject-info_codes.csv:* description of categorical variables
- *subject-info_definitions.csv:* definition of acronyms

- *RECORDS:* The full filename list of records

- HOLTER_ECG:
  - *PXXXX.dat*: data file containing the 24-h ECG signal,
  - *PXXXX.hea*: header with information about the recording format.

- High-resolution_ECG
  - *PXXXX_H.dat*: high-resolution, 12-lead, short ECG recording,
  - *PXXXX_H.hea*: header with information about the recording forma

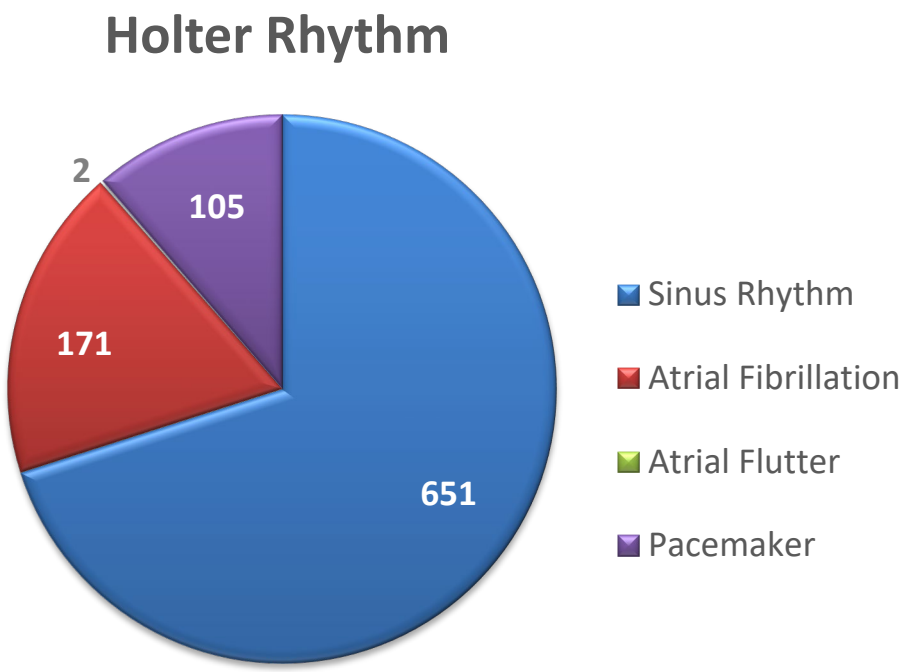


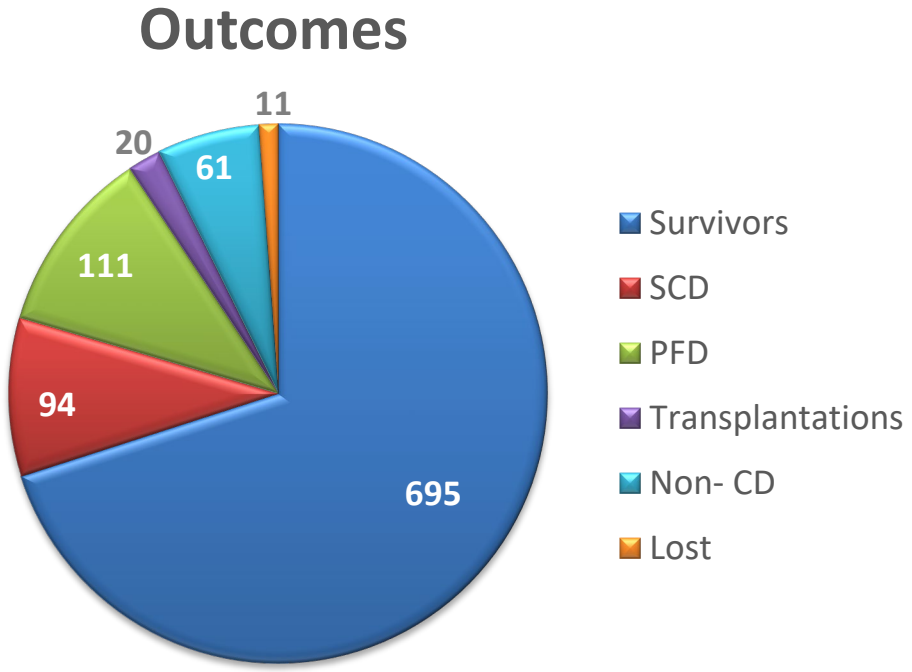
Data adquisition

- **Demographic and clinical variables:** age, gender, body mass index, blood pressure, NYHA, hypertension, heart failure etiology, diabetes, prior implantable device, etc.
- **Radiographic variables:** cardiothoracic ratio and signs of pulmonary venous hypertension.
- **Echocadiographic variables:** Left ventricular ejection fraction, left atrial size, end-diastolic and end-systolic diameters, mitral flow pattern and mitral insufficiency, etc.
- **Laboratory variables:** Haemoglobin, HDL, LDL, glucose, potassium, sodium, troponin, creatinine, TSH, etc.
- **ECG variables:** rhythm (sinus rhythm, atrial fibrillation and flutter or pacemaker), PR and QT intervals, QRS duration, presence of Q waves (necrosis).
- **Holter variables:** rhythm, mean heart rate, number of ventricular premature beats, ventricular extrasystoles and tachycardia, etc.
- **Medications:** Digoxin, beta-blockers, statins, diuretics, amiodarone, anticoagulants, calcium blockers, etc.

subject-info.csv
subject-info_codes.csv
subject-info_definitions.csv

Study population





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Clinical applications of MUSIC database

Ventricular repolarization

Repolarization dynamics (QT/RR):

QT/RR and T-peak-to-end/RR slopes are associated to both total CD and SCD.

Index of average alternans (IAA):

Long-term averaging of TWA acivity is a strong, independent predictor of SCD.

T-wave morphology restitution (TMR):

Morphological changes in the T-wave as a response to heart rate variations, specifically predict SCD with no association with PFD.

Autonomic function

Heart rate turbulence (HRT):

Turbulence slope (TS) is a potent risk predictor for both heart failure and SCD.

Segmented symbolic dynamics (SSD):

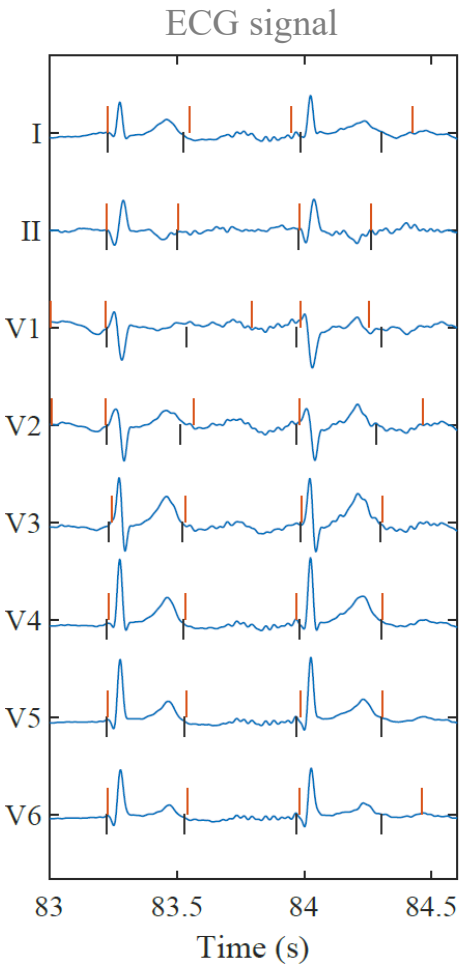
considerably enhances risk stratification in ICM patients in comparison to other HRV indices.

Periodic repolarization dynamics (PRD):

Sympathetic modulation of ventricular repolarization was shown to be an univariate predictor of SCD.

Clinical applications of MUSIC database

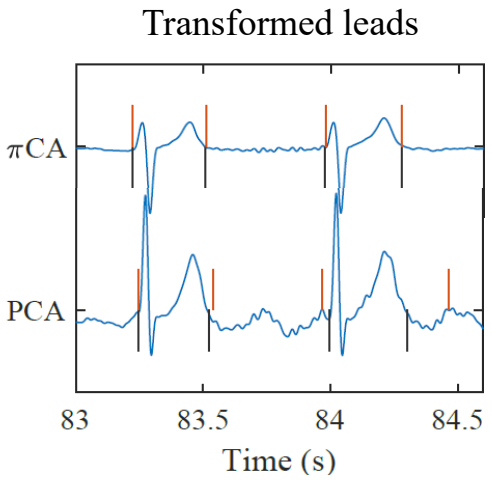
Atrial Fibrillation subcohort: development of CD risk indices during AF rhythm



Periodic component análisis (πCA)

Optimal linear combination to emphasize the 1-beat periodicity of the ECG

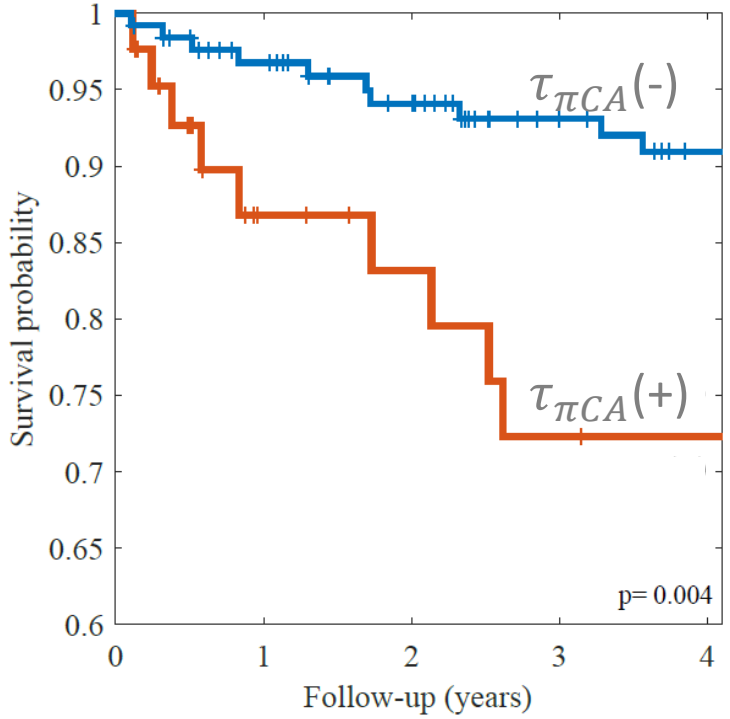
T-wave periodicity



Reference mark

Detected mark with wavelet* delineator

Kaplan-Meier estimator:
SCD endpoint



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Conclusions

- MUSIC database available on Physionet resource
  - Well-defined and homogeneous study population
  - collection of Holter and high-resolution ECGs
  - Complete records of clinical data (blood test, echo, X-Ray, ECG, medications)
  - 4-year follow-up information, including mortality endpoints

Contribution to the scientific community

valuable piece of data for the **development of prognostic models** and novel **ECG methodologies** aimed at **improving this risk stratification** in chronic heart failure.

Contributors

Patients in the MUSIC study were recruited thanks to the following Spanish Hospitals:

- Arrixaca Hospital (Murcia),
- Gran Canaria Insular Hospital (Las Palmas),
- Gregorio Marañón Hospital (Madrid),
- Joan XXIII Hospital (Tarragona),
- Santiago de Compostela University Hospital (Santiago de Compostela),
- Sant Pau Hospital (Barcelona),
- Son Dureta Hospital (Mallorca),
- Valme Hospital (Sevilla).

Thanks for your attention!

Questions?

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