Background

Thermoregulation is one of the fundamental aspects of homeostasis, which is a maintenance of constant conditions within the organism, irrespective of external environment. Humans, like all endotherms, have constant core body temperature (T_c), whereas skin temperature (T_s) is a subject to significant variations, depending on the surroundings. Virtually all cardiovascular diseases may lead to heart failure (HF), and as a result the incidence of HF rises globally. Apart from cardiac-related issues, there are numerous comorbidities, such kidney or liver failure, diabetes, anemia, cachexia, neoplasms, etc. in patients with chronic HF. Thus, optimal HF management should also take into account comorbidities. Based on the surrogate marker of systolic function – ejection fraction (EF), HF is divided into: HF with reduced EF (HFrEF), HF with mid-range EF (HFmrEF), and HF with preserved EF (HFpEF). Many symptoms, such as increased sweating, disproportionate feelings of being hot or cold, etc., that are reported by patients, may be easily-diagnosed manifestations of impaired thermoregulation. From small studies (typically 10-15 patients) and own observations, it seems that thermoregulation may be impaired in HF. Recent advancements in technology allow for the measurements of T_c (with ingestible temperature pills) and T_s (with skin surface adhesive pads). Infrared thermography (IRT) may be used to construct temperature skin maps of the whole body at rest and during exercise. Bioelectric impedance analysis (BIA) may help to estimate the hydratation status, including changes after volemic interventions (e.g. fluid challenge – FC and diuretic challenge – DC). The comprehensive assessment of thermoregulation and its relations with volemic status and exercise have never before been performed in HF.

Aim: The primary aim of the study is to investigate the subject of the relationships between thermoregulation and volemic status at rest and during exercise, in chronic HF.

Research project methodology

The study is planned for 36 months. The study population will be comprised of 120 patients (male or female) with chronic (of at least 3 months duration), stable HF (NYHA class I-II), between 18 and 70 years of age who will be recruited (according to specific inclusion and lack of exclusion criteria) during the first 18 months. Three sets of examinations (in at least 24-hour intervals) will be performed in different volemic statuses: (I) normal hydratation, (II) decrease of hydratation after DC, and (III) increase of hydratation after FC. Each set of examinations will include: a) assessment of hydratation status with BIA, b) a 12-minute treadmill exercise test, c) IRT, d) measurements of T_c, and e) measurements of T_s. In addition, monitoring of 24-hour (circadian) rhythms of T_c and T_s will be performed. The final telephone visit, including assessment of the occurrence of the combined clinical end-point will be performed at 12 months after recruitment.

Innovative nature of project and expected results

The project will broaden our understanding concerning thermoregulation in a representative cohort of HF patients. For the first time, we plan to use IRT to investigate T_s. Integration of 24-hour measurements of T_c and T_s will allow to monitor circadian temperature rhythms in HF for the first time. Uniquely, temperature measurements will be repeated three times: (1) at baseline, (2) after diuretic challenge, and (3) after fluid challenge in order to study the effect of hydratation status changes on temperatures and exercise performance. The dearth of data on this subject has resulted in a lack interest in thermoregulation, whereas in fact thermoregulation imbalances may be potentially considered another “comorbidity” in HF.