BRIEF REPORT

Safety, Acceptance, and Physiologic Effects of Sauna Bathing in People With Chronic Heart Failure: A Pilot Report

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ABSTRACT. Basford JR, Oh JK, Allison TG, Sheffield CG, Manahan BG, Hodge DO, Tajik AJ, Rodeheffer RJ, Tei C. Safety, acceptance and physiologic effects of sauna bathing in people with chronic heart failure: a pilot report. Arch Phys Med Rehabil 2009;90:173-7.

Objectives: To perform a pilot study and make a preliminary assessment of the safety and acceptance of supervised sauna bathing at moderate temperatures in people with chronic heart failure (CHF). Secondary measures included its impact on exercise tolerance and neuroendocrine concentrations.

Design: Randomized, controlled, cross-over trial.

Setting: Physical medicine and rehabilitation clinic.

Participants: Six men and 3 women (age, 62–87y) with New York Heart Association Class III and IV CHF.

Interventions: Subjects were randomized into 2 groups and told to maintain their normal medication and activity regimens. One group then began a 3-times-a-week, 4-week sauna bathing program at 60±1°C while the other continued with their usual activities and medications. Assignments were then reversed. Sessions were 15 minutes in length but were prolonged an additional 5 minutes for oral temperature increases less than 1.0°C.

Main Outcome Measures: Patient acceptance, Minnesota Living With Heart Failure Questionnaire (MLWHFQ) scores; treadmill exercise duration and plasma adrenaline, noradrenalin, aldosterone, atrial naturectic factor, adrenomedulin, and endothelin.

Results: Sauna bathing was well tolerated and no adverse effects were reported. Improvements in MLWHFQ scores and treadmill endurance did not achieve statistical significance on a between-group basis but were more marked after the sauna than during the control phase. Neuroendocrine concentrations showed no clear effect of sauna treatment with a between-group statistically significant difference (P=.049) found only in the case of noradrenalin's 24% decrease.

Conclusions: Sauna bathing under the moderate and supervised conditions of this study appears to be well tolerated and may be safe for people with CHF. More research is needed to further evaluate the safety and potential benefits of this approach.

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CHRONIC HEART FAILURE affects about 5 million Americans and is a leading cause of hospitalization among the elderly.[1] Our understanding of the condition has improved markedly over the years and treatment now may take into account the influences of peripheral vascular activity, heart rate, and cardiac contractility as well as the potentially cardiotoxic effects of the neuroendocrine hormones.[2,3] Our views of the nature and treatment of this condition will undoubtedly continue to change; it may be that activities such as exercise that were once thought to be harmful[4] may also prove to be innocuous or even beneficial.

Sauna bathing may be a case in point, because systemic hyperthermia is often proscribed for people with heart disease and failure. This proscription at first glance appears reasonable in that hyperthermia increases heart rate and cardiac output, and, thereby potentially cardiac stress. However, the facts may not support this view. For example, although heat does increase cardiac rate and output, it also has potential benefits in the form of afterload reduction from vasodilation and salt loss. In addition, many people, including some with heart disease, have long found sauna bathing pleasurable and relaxing.[5,6] More recent research adds support to a benign view of sauna bathing in that it finds that hyperthermia appears to improve left ventricular function and vascular activity in people with cardiac and peripheral vascular disease.[7-9] This work, however, focuses on cardiac and vascular parameters. Far less is known about the effects of controlled hyperthermia exposure on the functional activities, exercise tolerance, and neuroendocrine profiles of people with heart failure and cardiac disease.

The question arises whether this prohibition on sauna bathing is overly restrictive. It may be that not only are safety concerns needlessly limiting the activities of people with CHF, but also that excessive caution is preventing the use of a potentially beneficial modality.

Problem Statement

This pilot study had 4 goals. The primary goal was to make a preliminary assessment of the safety and acceptance of sauna bathing at moderate temperatures on people with CHF. The

List of Abbreviations

BP	blood pressure
CHF	chronic heart failure
CID	clinically important difference
MLWHFQ	Minnesota Living With Heart Failure Questionnaire
NYHA	New York Heart Association

second was to assess the impact of sauna bathing on the subjects' quality of life and exercise tolerance. The third consisted of monitoring a number of cardiotoxic neuroendocrine hormones with the thought that changes in their concentrations might provide information about sauna bathing's physiologic effects. Our final goal was to estimate the sample sizes necessary to establish the benefits of sauna bathing in a definitive randomized controlled trial.

METHODS

Subjects

This study was approved by the Mayo Clinic Institutional Review Board. Inclusion criteria included age 18 years or older, stable NYHA Class III or IV CHF, left ventricular ejection fraction of less than 40% and maintenance of a stable activity and pharmacologic regimen for at least a month. Subjects were also required to agree to participate in treadmill exercise testing and a 3-times-a-week, 4-week sauna program. Exclusion criteria included significant (more than moderate) valvular stenotic disease, fever, diabetes mellitus, history of symptomatic lung disease, myocardial infarction within 3 months, the presence of an implantable cardioverter-defibrillator or pacing device, or a history of sustained ventricular dysrhythmia.

Methods

The goals and procedures of this randomized, crossover study were reviewed with potential participants by one of the investigators. Volunteers were assessed by one of 2 cardiologists (J.K.O. and A.J.T.) who were members of the team. Those meeting the inclusion and exclusion criteria then signed an informed consent form. The investigators assessed the subjects at an initial baseline visit as well as at the completion of each treatment assignment.

Baseline evaluation included an interview and physical examination during which demographic variables, medication use, and vital signs were collected. Subjects also filled out the well-validated 21-item MLWHFQ about the effect of CHF on their lives[10] and answered 2 global questions; "How much does heart failure affect your life?" (6-point scale ranging from "no effect" to "very large effect") and "How much has the treatment you received in the last 4 weeks changed your way of life?" (5-point scale ranging from "much worse" to "much better"). Subjects also underwent standard clinical treadmill exercise testing according to American College of Cardiology/American Heart Association standards with a modified Naughton Protocol.[11] Tests were symptom-limited (rating of perceived exertion$<$19 on standard Borg scale) and administered by test personnel who were blinded to patient assignment and provided no special coaching). Blood sampling to obtain resting adrenaline, noradrenaline, aldosterone, atrial naturectic factor, adrenomedulin, endothelin, and cyclic guanosine monophosphate plasma concentrations was done prior to participation in study activities. Subjects then underwent a 15-minute sauna bath trial (see below) with blood pressure, heart rate, oral temperatures, and weight obtained immediately before and after treatment as well as 30 minutes later.

We randomized the subjects into 2 groups. One group began a 3-times-a-week, 4-week sauna bathing program (ie, the "sauna phase" in our hospital's rehabilitation clinic) while the members of the other served as controls. Subjects were instructed to maintain their normal drug regimens and usual level of activities throughout the study period.

Subjects were reassessed at the end of the treatment period (within 48 hours of the last session for those in the sauna phase) in the manner outlined above. Assignments were then reversed with those in the previous phase's control group undergoing the sauna regimen, and those that had been enrolled in the sauna phase no longer undergoing saunas but otherwise maintaining their normal level of activities. A third and final assessment occurred 4 weeks later.

Table 1: Demographic Data

Subject Demographics	
Variable	Value
N	9
Men/women	6/3
Age (y)	71.6±9.8
Height (cm)	171.2±8.0
Mass (kg)	80.3±19.2
Body mass index (kg/m^2)	28.6±3.7
Previous myocardial infarction	3
NYHA functional class	
III	7
IV	2
Left ventricle ejection fraction (%)	20.0±6.9

NOTE. Values are mean ± SD.

Equipment and Procedures

Sauna treatments were performed individually in a previously described dry sauna bath.[6] Heart rate, BP, body weight, and oral temperatures were obtained immediately before each session. The subject then lay supine in the sauna at 60±1°C for 15 minutes (extended to 20 minutes if an oral temperature increase of 1.0°C had not been achieved). Subjects were then wrapped in dry blankets and lay quietly for an additional 30 minutes before being dried and reweighed. Subjects losing more than 454g (1lb) were given 300 to 400ml of water to drink; those losing lesser amounts were given half that amount. Adverse events were defined as any undesirable outcome ranging in severity from the serious (eg, dysrhythmias, palpitations, increasing dyspnea, and angina) to patient complaints of discomfort. All sessions were monitored by a trained physical therapist and occurred during normal business hours in close proximity to cardiologists in a nearby Cardiovascular Health Clinic.

Data and Statistics

Baseline measurements were compared with those obtained at the 4- and 8-week intervals marking the end of the treatment phases with rank-sum and 2-tailed paired *t* tests as appropriate. Changes were considered significant if *P* values were less than or equal to 0.05. All data are expressed as mean ± SD.

RESULTS

Demographics

Six men and 3 women with ages ranging from 62 to 87 years participated in the study. All were on stable pharmacologic regimens; 7 were categorized as NYHA Functional Class III and 2 as Class IV at the time of initial screening (table 1).

Clinical Outcomes

There were no adverse events. Subjects tolerated the sauna sessions well with 3 desiring to continue bathing after the study's close. One patient was reassigned from a screening assignment of NYHA Class III to Class II at their baseline session. NYHA scores showed a trend towards improvement in