Dietary Sodium Adherence Is Poor in Chronic Heart Failure Patients

ANUPAM BASURAY, MD, MPH,[1] MARY DOLANSKY, RN, PhD,[2] RICHARD JOSEPHSON, MS, MD,[3,4] ABDUS SATTAR, PhD,[3] ELLEN M. GRADY, MNO,[2] ANTON VEHOVEC, BSN,[2] JOHN GUNSTAD, PhD,[5] JOSEPH REDLE, MD,[6] JAMES FANG, MD,[7] AND JOEL W. HUGHES, PhD[5]

Columbus, Cleveland, Kent, and Akron, Ohio; and Salt Lake City, Utah

ABSTRACT

Background: We sought to determine the rates and predictors of dietary sodium restriction and to evaluate the reliability of 24-hour urine collection as a tool to estimate dietary sodium intake in heart failure (HF) patients.

Methods and Results: We evaluated the 24-hour urinary sodium excretion of 305 outpatients with HF and reduced ejection fraction who were educated on following a <2 g sodium diet. The mean sodium excretion according to a single sample from each participant was 3.15 ± 1.58 g, and 23% were adherent to the <2 g recommendation. One hundred sixty-eight participants provided 2 samples with urinary creatinine excretion within normative range. Averaging both resulted in a mean sodium excretion of 3.21 ± 1.20 g and lower adherence rates to the <2-gram diet: 14% versus 23% ($P = .019$). Multivariate logistic regression showed only male sex and higher body mass index (BMI) to be associated with nonadherence (male: odds ratio [OR] 2.20, 95% confidence interval [CI] 1.25−3.88; 1 unit BMI: OR 1.05, 95% CI 1.01−1.10). Bland-Altman plots of urinary sodium and creatinine showed poor reproducibility between samples.

Conclusions: In this chronic HF population, sodium consumption probably exceeds recommended amounts, particularly in men and those with higher BMI. Urine analyses were not highly reproducible, suggesting variation in both diet and urine collection. (*J Cardiac Fail 2015;21:323−329*)

Key Words: Sodium, salt, compliance, diet.

The average daily American diet contains >4 g sodium, an amount that may lead to an exacerbation of symptoms as well as other adverse effects in adults with heart failure (HF).[1] As a result, several major medical groups have developed guidelines to limit sodium consumption. The Heart Failure Society of America (HFSA) suggests a daily consumption of ≤2−3 g sodium in the HF population, depending on HF severity.[2] Previously, the American Heart Association (AHA) recommended changing the guideline from <3 g to an even more stringent <1.5 g sodium diet for all individuals regardless of a history of cardiac disease.[3] The variability of these guidelines is due in part to a lack of robust data in specific populations (eg, HF). As a result, the most recently updated American College of

From the [1]OhioHealth Heart and Vascular Physicians, Riverside Methodist Hospital, Columbus, Ohio; [2]Frances Payne Bolton School of Nursing, Case Western Reserve University, Cleveland, Ohio; [3]Department of Epidemiology and Biostatistics, School of Medicine, Case Western Reserve University, Cleveland, Ohio; [4]Harrington Heart and Vascular Institute, University Hospitals, Cleveland, Ohio; [5]Department of Psychology, Kent State University, Kent, Ohio; [6]Summa Health System, Akron City Hospital, Akron, Ohio and [7]Division of Cardiology, Department of Internal Medicine, University Hospital, Salt Lake City, Utah.

Manuscript received May 27, 2014; revised manuscript received December 11, 2014; revised manuscript accepted December 29, 2014.

Reprint requests: Anupam Basuray, MD, MPH, OhioHealth Heart and Vascular Physicians, Riverside Methodist Hospital, 3525 Olentangy River Road, Suite 6300, Columbus, OH 43214. Tel: 614-566-3175. E-mail: anupambasuray@gmail.com

Funding: National Heart, Lung, and Blood Institute (R01 HL096710−01A1 awarded to Drs Dolansky and Hughes.

Clinical Trial Registration: Heart Adherence Behavior and Cognition Study (Heart ABC) Identifier: NCT01461629 http://clinicaltrials.gov/ct2/show/NCT01461629?term=self+management+heart+failure&rank=5.

See page 329 for disclosure information.

1071-9164/$ - see front matter

http://dx.doi.org/10.1016/j.cardfail.2014.12.016

Cardiology Foundation (ACCF)/AHA heart failure guidelines downgraded sodium restriction in HF from a class I to a class IIa recommendation and limited the 1.5 g restriction to stage A and B HF only, leaving stages C and D without a clear recommendation.[4]

Although there is uncertainty as to the exact recommendation, patients with HF are instructed to limit their dietary consumption of sodium. Existing data on dietary sodium intake in patients with HF have a number of methodologic limitations, such as small sample sizes,[5−7] use of self-report food diaries,[5,8,9] and use of single urinary sodium collection to characterize intake.[6,10,11] In the present analysis, we used 24-hour urinary sodium excretion as an objective measure of sodium intake in a community-based sample of an adult HF population. Our aim was to determine the rates of adherence to dietary sodium restriction, to determine the predictors of adherence, and to evaluate the reproducibility of the urine samples provided by study participants.

Materials and Methods

Study Population

The present study is a secondary analysis from the Heart ABC Study (Adherence, Behavior, and Cognition), a National Institutes of Health−funded, ongoing longitudinal study examining the relationships among cognitive impairment and adherence to HF self-management (ClinicalTrials.gov identifier: NCT01461629). Every participant provided written informed consent, and the study was approved by the Human Subjects Review Board at the 2 participating health systems: University Hospitals Case Medical Center in Cleveland, Ohio (a quaternary-care academic system), and Summa Health Systems in Akron, Ohio (a tertiary-care community-based system).

Adults recruited into the parent study were aged 50−85 years with a clinical history of HF (≥3 months) and LV dysfunction (ejection fraction ≤40% according to standard clinical methodology: left ventricular angiography, nuclear imaging, or echocardiography within 36 months of study enrollment). All participants were clinically stable as determined by no change in diuretic dose or regimen, no planned hospitalization, and no planned procedures. Participants were enrolled from outpatient clinic settings. Adults with conditions known to be highly associated with cognitive dysfunction were excluded. Specifically, exclusion criteria were cardiac surgery within the past 3 months, history of neurologic disorder or injury (eg, Alzheimer disease, dementia, stroke, seizures), history of moderate or severe head injury, history of or current psychotic disorders, bipolar disorder, learning disorder, developmental disability, renal failure requiring dialysis, or untreated sleep apnea, and current substance abuse or within the past 5 years.

On enrollment, all patients received an educational handout entitled "Managing Your Heart Failure." This handout, created by Case Western Reserve University and approved by the Institutional Review Board at both sites, included recommendations for lower sodium dietary choices and recommended a <2 g sodium diet. Participants were asked if they understood the <2 g sodium restriction and provided additional verbal assistance, if necessary. Participants may have also received additional dietary education from physicians, nurses, or dieticians as part of their "usual" HF care. Each participant had 3 weeks to apply these guidelines to their daily routine before assessment of dietary sodium consumption.

At the time of enrollment, detailed clinical and demographic data were obtained by means of standardized questionnaires administered to the participant and were verified by examining medical records. The Charlson comorbidity index was used to assess comorbid conditions.[12] Medical diagnoses were assigned points (1−4), with more severe conditions receiving higher points. A total score was calculated.

Estimating Dietary Sodium

In this study, 24-hour urinary sodium excretion was used to estimate adherence to guideline-based low dietary sodium recommendations for HF. Urinary sodium excretion is highly correlated with dietary intake in patients with HF, with >95% of intake being excreted in the urine in temperate climates.[13] Urinary sodium excretion may provide a more accurate assessment of sodium intake, because self-report food diaries often result in an underestimation of consumption.[14] To ensure adequate urine collection, a protocol was put in place to educate and assist in the collection of specimens. The parent study consisted of 4 home visits. At the 2nd home visit, participants were given a collection device, urine jug, and both verbal and written instructions to collect all urine within a 24-hour window. Participants were instructed to collect a 24-hour sample ending on the morning of the 3rd home visit. As a reminder, participants were telephoned 1 day before collection to ensure protocol fidelity. Participants were instructed to keep samples cold by storage in refrigerators and were responsible for reporting the collection start and stop times. Study personnel retrieved the urine samples during the 3rd home visit. Additionally, to account for intra-individual variation in sodium intake, we collected 2 24-hour urinary sodium measures on a majority of participants. During the 3rd home visit, participants were given a 2nd collection device, jug, and instructions for their 2nd urine collection to be picked up on the 4th home visit, approximately 1 month later. Participants were again reminded 1 day before the second collection day, and the process was repeated as above.

Data Analysis

Data analyses were performed with the use of Stata 11.0. Statistics including frequencies with percentages and means with standard deviations were used to describe patient characteristics as well as urine sodium excretion and urine creatinine excretion. Adherence to sodium restriction recommendations was determined if the subject's urinary sodium excretion was below investigator-determined cutoff values based on 2 national society recommendations for daily sodium consumption: <2 g/d and <3 g/d. Various proportions of participants who maintained sodium restrictions were tested with the use of proportion tests. Continuous and categoric variables were summarized for different subgroups. Summary statistics are presented, and group differences were determined with the use of either *t* tests or chi-square statistics. A multivariate logistic regression on dietary sodium adherence was performed according to the least stringent recommendation of <3 g. This value was suggested as a possible target for class C or D HF patients according to the latest ACCF/AHA recommendations.[4] A binary logistic regression analysis on excreted sodium (<3 g vs ≥3 g) and clinically relevant covariates were performed on this cohort. In the single-predictor unadjusted