D-ribose aids congestive heart failure patients

Heyder Omran MD[1], Dean McCarter PhD[2], John St Cyr MD PhD[2], Berndt Lüderitz MD FESC FACC FAHA[1]

H Omran, D McCarter, J St Cyr, B Lüderitz. D-ribose aids congestive heart failure patients. Exp Clin Cardiol 2004;9(2):117-118.

Patients with congestive heart failure often experience fatigue despite intensive pharmacological therapy. Ribose can aid the recovery of ATP levels and, hence, diastolic function. Clinical trials have shown that ribose supplementation improves ischemic threshold and enhances diastolic function in congestive heart failure.

Key Words: *Heart failure; Ischemia; Metabolism; Ribose; Ventricular function*

We have compelling, but preliminary, data to suggest that D-ribose may be of benefit in congestive heart failure (CHF). CHF patients commonly experience fatigue, decreased exercise tolerance and limitations in activities, all attributable to their dysfunctional cardiac condition. The preservation of, or improvement in, left ventricular diastolic function has been a therapeutic goal in CHF because of its important relationship to improving functional capacity/exercise performance of daily activities. Conventional pharmacological therapy (diuretics, digoxin, angiotensin-converting enzyme inhibitors, beta-blockers, etc) is initially employed: however, success is not always guaranteed. No standardized secondary pharmaceutical therapy exists and, therefore, novel therapeutic options are being sought.

ATP is essential for myocardial cellular integrity and function; however, in ischemic heart disease, ATP levels can be reduced, with supply not meeting demand. Experimentally, hearts subjected to moderate periods of ischemia while on cardiopulmonary bypass demonstrate an approximate 50% reduction in myocardial ATP levels following ischemia (1), and with reperfusion, a considerable amount of time, as much as nine to 10 days, is required for complete recovery (2). Further, reduced myocardial energy levels have been found to reflect a temporal relationship with diastolic dysfunction, which improves as ATP levels recover (3). Diastolic relaxation is energy dependent, requiring adequate levels of ATP to pump cytosolic calcium into the sarcoplasmic reticulum. Lower myocardial ATP levels allow calcium to remain fixed to troponin longer in diastole, leading to a myocardial dysfunctional state (4).

The pentose phosphate pathway (PPP) aids in replenishing depressed ATP levels; however, rate-limiting enzymatic steps in the PPP account for a sluggish recovery following ischemia or anoxia. Supplemental ribose enters the PPP, bypassing the rate-limiting steps, leading to the formation of adenine nucleotides. Animal studies investigating the role of D-ribose following global ischemia have demonstrated that left ventricular diastolic compliance is linked to myocardial ATP levels (5,6). Further, the recovery of ATP levels and diastolic function enhanced by ribose can be reversed if ribose supplementation is discontinued early in the recovery. Longer infusion periods are required to maintain the desired effect (7).

Human clinical trials have also found similar benefits from ribose. Pliml et al (8) reported that daily doses of D-ribose enabled patients with stable severe coronary artery disease to increase their 'ischemic threshold', reflected in their ability to exercise longer with fewer symptoms or potential electrocardiographic changes. Recently, Illien et al (9) reported significant benefits of daily oral D-ribose in class II and III (New York Heart Association) CHF patients in a double blind, randomized crossover study. Supplemental D-ribose demonstrated a significant improvement in diastolic compliance with comparable measurements pertaining to left atrial function. Of equal importance, ribose also demonstrated a significant improvement in quality of life (Medical Outcomes Study 36-Item Short Form Health Survey questionnaire) and physical function activity scoring (9).

The prevalence of CHF has markedly increased over the decades. In the early 1990s, it was estimated that in the United States, approximately 4.6 million individuals were afflicted with CHF, approximately 400,000 new cases were diagnosed each year and approximately 260,000 deaths from CHF occurred each year, with an estimated five-year mortality rate of approximately 50% (10). Further, the health care cost in the United States for heart failure was reported to be US$38.1 billion, with US$23 billion spent on inpatient care, more than US$14.5 billion in outpatient therapy and slightly more than US$250 million in heart transplantation (10). As the incidence of CHF continues to increase, therapeutic dollars spent on this disease will also have a correlative rise. Pharmacological regimens are still the approved standard in treating patients with heart failure; however, each pharmaceutical agent has accompanying adverse side effects. The use of ribose in CHF patient daily therapy may offer a benefit by itself or may potentiate pharmaceutical therapies, which could lead to a decrease in health care cost.

[1]*Department of Medicine/Cardiology, University of Bonn, Bonn, Germany;* [2]*Bioenergy Inc, Ham Lake, Minnesota, USA*
Correspondence: Dr John St Cyr, 940 Fernbrook Lane North, Minneapolis, Minnesota 55447, USA. E-mail LMS94@aol.com

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