



Research Summary

Ribose

While recent pharmaceutical discoveries have significantly reduced the morbidity and mortality associated with congestive heart failure, drug therapy is limited in its ability to keep up with disease and/or symptom progression. Once maximum dose levels are reached, the remaining treatment options are invasive, risky, and have the potential to limit life. With little else in the traditional medicine chest to treat failing hearts, physicians are increasingly turning to natural therapies for symptom management. Ribose, an all-natural nutrient associated with energy restoration, has shown significant promise.

Heart Failure

According to the American College of Cardiology, heart failure (HF) is a syndrome caused by myocardial muscle dysfunction and characterized by left ventricular dilation or hypertrophy. Heart failure causes neurohormonal and circulatory abnormalities, leading to fluid retention, shortness of breath, and fatigue. Clinical symptoms may vary substantially during the course of the disease process and may not correlate with changes in underlying cardiac function.¹ Heart failure severity is defined by the New York Heart Association (NYHA) classification system, falling into one of four categories (see Figure 1).

Figure 1: NYHA Classification of Congestive Heart Failure Severity

| NYHA Class | Definition |
|------------|---|
| I | Patients with cardiac disease but no resulting limitation of physical activity. No fatigue, palpitations, shortness of breath or angina during normal physical activity. |
| II | Patients with cardiac disease and slight limitation of physical activity. Normal physical activity results in symptoms of heart failure or angina but the patient is comfortable at rest. |
| III | Patients with cardiac disease and marked limitation of physical activity. Minimal physical activity results in fatigue, palpitations, shortness of breath, or angina but comfortable at rest. |
| IV | Patients with cardiac disease and inability to carry out physical activity without discomfort. Even at rest, the symptoms of heart failure or angina may be present. |

More than 5 million Americans are living with heart failure, and 550,000 new cases are diagnosed each year.² A recent study conducted at the Mayo Clinic, Rochester, Minnesota reported that 25% of all adults over age 45 in the United States exhibit mild to severe symptoms of diastolic dysfunction and CHF.³ Practitioners who care for patients with HF are challenged daily with preventing common, recurrent rehospitalizations for exacerbations. Most of the staggering cost associated with the care of HF patients is attributable to hospitalizations.²

While the advent of angiotensin converting enzyme inhibitors, beta-blockers, and other HF pharmaceuticals has significantly changed heart failure management, drug therapy is often limited in its ability to keep up with progression of the disease. Once maximum dose levels are reached, the only remaining treatment options are heart transplant or ventricular assistive device insertion.¹ Recognizing these limitations in traditional care has led to the use of integrated and natural therapies that have demonstrated markedly improved outcomes. Ribose, a simple five-carbon sugar present in all living cells, has shown great effect.

Ribose

Ribose is a naturally occurring pentose carbohydrate that:

- Does not exist in food as a free standing compound
- Is created in the body from nutrients found in food
- Is required by all cells for the synthesis of the energy-yielding molecule adenosine triphosphate (ATP) (see Figure 2 - next page).⁴
- When produced in the body (endogenous ribose), might not be made quickly enough to adequately restore depleted energy stores.
- Given exogenously, is proven to replenish energy production in cardiac tissue.⁵

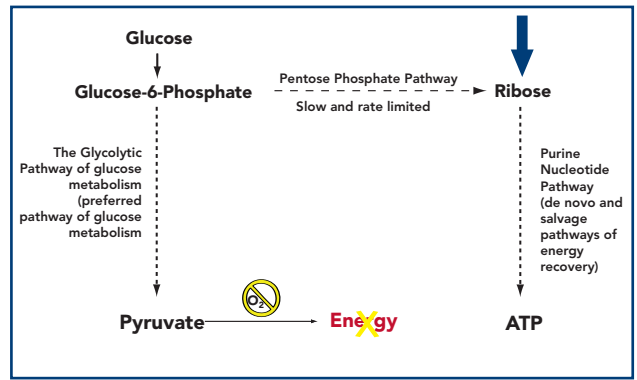
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Ribose and Heart Failure

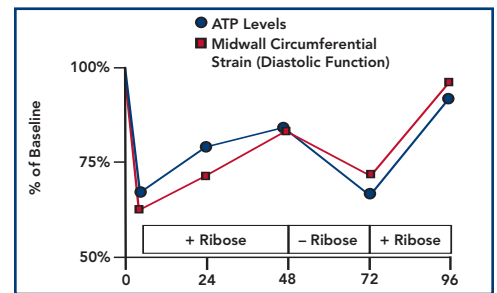
Clinical studies have shown that ribose supplementation has a direct impact on cardiac diastolic function, physical function, and quality of life in patients suffering from HF and should be included in treatment regimens (see Figure 3). No other compound regulates the energy synthetic pathways necessary to perform this important, and vital, metabolic function. As preclinical symptoms of diastolic dysfunction often go unnoticed, it has been suggested that all adults at risk for HF, be supplemented with ribose to maintain cardiac energy reserves.⁵

Figure 2: Ribose Corrects Deficiency



A recent crossover study (Omran, 2003) investigated the effect of D-ribose on myocardial function, performance status, and quality of life in fifteen patients with heart failure secondary to coronary artery disease (CAD). After a baseline echocardiogram and completion of a self-administered quality of life questionnaire, the subjects were randomized to receive either D-ribose or placebo for the first 3-week treatment periods. Following a one week washout, the second 3-week treatment period commenced with the subjects again receiving either oral D-ribose or placebo.

Figure 3: The Effect of Ribose on Energy and Diastolic Function in Working Hearts



The findings demonstrated an enhanced atrial contribution to left ventricular filling (P=0.02), a smaller left atrial dimension (P=0.02) and a shortened E wave deceleration (P=0.002) following D-ribose administration. Furthermore, D-ribose administration was associated with significant improvement in the subjects' quality of life (P< or =0.01). Administration of the placebo did not result in any significant echocardiographic changes or improvements in quality of life.⁵

Additional study findings are summarized in the chart that follows:

| Disease | Study Design/Findings | Dosage |
|---|--|--|
| Coronary Artery Disease | Randomized, double blind, placebo controlled involving 20 patients with CAD and stable angina. ⁵ • Ribose increased treadmill walking time to ST segment depression; nearly 20% greater improvement versus placebo • After 3 days, also improved the heart's tolerance to ischemia | 15-g ribose qid or placebo (glucose) |
| Coronary Artery Disease/Congestive Heart Failure | Prospective, randomized, double blind, placebo controlled, crossover design study to assess effects of D-ribose supplementation in 15 patients with CAD and CHF (Class II – III). ⁶ • Ribose led to an enhancement of atrial contribution to left ventricular filling, a smaller left atrial dimension, and a shortened E wave deceleration by echocardiography • Resulted in a 12% increase in quality of life as measured on validated scale | Ribose or placebo 3 weeks / washout / crossover |
| Congestive Heart Failure (CHF) | Fourteen CHF patients (NYHA Class II – III) were enrolled in a double blind, placebo controlled, crossover design. Maximal cycle ergometry with gas exchange was monitored pre- and post- each treatment period. ⁷ • With exercise, ribose-treated CHF patients maintain better ventilatory efficiency, a strong predictor of heart failure survival • Also improved VO2max, reduced shortness of breath, increased exercise tolerance, and increased hypoxic threshold vs. placebo | 5-g ribose or placebo tid (8 weeks on each test substance) |
| Open Heart Surgery | Randomized, double blind trial with 27 open heart patients. ⁸ • Ejection fraction in placebo group significantly depressed following 7-days of post-surgical recovery • At 7 days, 80% of placebo group demonstrated decline, whereas only 20% of the ribose group experienced decline | Glucose with 20% ribose (100mg/kg/hr) or placebo (glucose alone) administered IV |
| Coronary Artery Disease: Pre-Surgical Revascularization/ "Off" Cardiopulmonary Bypass | A comparison of the results of 143 patients receiving D-ribose as an oral "pre-op" versus 40 historical patients following a similar protocol, without supplementation. ⁹ • "Off" pump cardiopulmonary bypass with supplemental ribose resulted in no peri-operative deaths and no post-operative myocardial infarctions • Ribose treated patients showed a 43% improvement in cardiac index (cardiac output/surface area) vs. 13% with historical controls without ribose | 2 – 21 doses, 5-g each (average 6.75 doses) |
| Congestive Heart Failure | An 8-week open-label clinical trial with 15 congestive heart failure patients (Class III (9) and IV (6)) undergoing cardiopulmonary testing. ¹⁰ • O2 uptake efficiency, stroke volume (O2 pulse), and ventilatory efficiency, the most powerful predictor of patient survival, were significantly improved following supplementation with D-ribose | 5-g tid for 8-weeks |

Conclusion

The physiological benefit of ribose administration in HF is clear. Ribose supplementation improves diastolic heart function, increases exercise tolerance, and enhances patient quality of life.

