Ribose Preserves Ventricular Function Following Aortic Valve Surgery

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Citation

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Abstract

Patients with aortic valve disease can present with different clinical symptoms, ranging from minimal exertional difficulties to progressive heart failure. With progression of disease, cardiac hypertrophy or dilatation can produce a state of myocardial dysfunction, further limiting functional capacity even with aggressive pharmaceuticals. Patients at this stage have few options and may eventually undergo valve replacement due to compromised ventricular function.

Experimental animal models producing cardiac hypertrophy with subsequent failure have revealed low myocardial high-energy phosphate levels, which are speculated as a plausible mechanism contributing to failure.[1,2,3] Neubauer et al. and Hardy et al. reported that an impairment in high-energy phosphate metabolism occurs in heart failure patients with cardiomyopathy.[4, 5] Conway et al. reported that patients with aortic valve disease have a normal phosphocreatine-adenosine triphosphate ratio in the absence of failure[6] ; however, this ratio decreases substantially when heart failure develops.[6,7] More recently, Ingwall and Weiss have reviewed the need of energy in the failing heart and point out that therapies should address this mechanistic issue for the most effective therapeutic benefit.[8] A myocardial energy imbalance has been shown to correspond to a state of diastolic dysfunction[7,9], affecting a patient's mortality and morbidity.

D-ribose, a naturally occurring pentose sugar, has shown to enhance the recovery of depressed myocardial ATP molecules and improve diastolic dysfunction following reversible global ischemia in animal studies.[9, 10] Clinically, ribose has demonstrated a similar benefit in class II and III congestive heart failure patients by improving diastolic function, quality of life, and physical function.[11] Knowing that patients with advanced aortic valve disease might have abnormal myocardial energetics and function, ribose may offer a benefit to these patients.

Vance et al. investigated the role of D-ribose in patients undergoing aortic vlave replacement for aortic valve disease. Twenty adult patients with a pre-operative ejection fraction of at least 35% were randomized into two equally matched study groups.[12] Once randomized, one group received intravenous D-ribose in D_5W and the other intravenous D_5W (placebo) peri-operatively. Serial echocardiographic and hemodynamic assessments were performed at baseline and post-operatively in all patients. Eighty percent of the placebo treated patients sustained a decline in their ejection fraction (EF) of greater than 15% at post-operative day 7 compared to baseline assessment (p=0.0025). In contrast, only 20% of the ribose treated patients demonstrated a reduction of at least 15% in their ejection fraction (p=0.49). Due to different echocardiographic mode assessments used throughout the study, transesophageal and trans-thoracic, no comparison of other functional parameters was possible. There was no significant difference in hemodynamic parameters.

This positive hemodynamic finding by Vance et al. revealed yet another benefit of D-ribose in patients undergoing aortic valve replacement. Assuming that a metabolic abnormality may exist with advanced aortic valve disease and that a potential functional compromise may evolve following cardiopulmonary bypass surgery, novel efforts should be considered in replenishing and/or maintaining myocardial energy levels and thereby aiding in preserving post-operative function. >From these above reported studies, D-ribose may offer such a solution to this dilemma.

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References

1. Minton PR, Zoll PM, Norman LR. Levels of phosphate compounds in experimental cardiac hypertrophy. Circ Res 1960; 8:924-9.
2. Pool PE, Spann JR, Buccino RA, Sonnenblick EH, Braunwald E. Myocardial high-energy phosphate stores in cardiac hypertrophy and heart failure. Circ Res 1967; 21:365-73.
3. Zhang J, Merkle H, Hendrich K, Garwood M, From AHL, Ugurbil K, Bache RJ. Bioenergetic abnormalities associated with severe left ventricular hypertrophy. J Clin Invest 1993; 92:993-1003.
4. Neubauer S, Krahe T, Schindler R, Hillenbrand H, Entzeroth C, Horn M, Bauer WR, Stephen T, Lackner K, Haase A, Ertl G. Cardiac 31P-magnetic resonance spectroscopy of volunteers and patients with coronary artery disease and dilated cardiomyopathy. Altered cardiac high-energy phosphate metabolism in heart failure. Circulation 1992; 86:1810-8.
5. Hardy CJ, Weiss RG, Bottomley PA, Gerstenblith G. Altered myocardial high-energy phosphate metabolites in patients with dilated cardiomyopathy. Am Heart J 1991; 122:795-801.
6. Conway MA, Allis J, Ouwerkerk R, Niioka T, Rajagopalan B, Radda GK. Detection of low phosphocreatine to ATP ratio in failing hypertrophied human myocardium by 31P magnetic resonance spectrospocy. Lancet 1991; 338:973-6.
7. Neubauer S, Horn M, Pabst T, Harre K, Stromer H, Bertsch G, Sandstede J, Ertl G, Hahn D, Kochsiek K. Cardiac high-energy phosphate metabolism in patients with aortic valve disease assessed by 31P-magnetic resonance spectroscopy. J Invest Med 1997; 45: 453-62.
8. Ingwall JS, Weiss RG. Is the failing heart energy starved? On using chemical energy to support cardiac function. Circ Rev 2004; 95:135-45.
9. Schneider JR, St.Cyr JA, Mahoney JR, Bianco RW, Ring WS, Foker JE. Recovery of ATP and return of function after global ischemia. Circulation 1985; 72(4):III-298.
10. Tveter K, St.Cyr J, Schneider J, Bianco R, Foker J. Enhanced recovery of diastolic function after global myocardial ischemia in the intact animal. J Am Coll Cardiol 1989; 13:130.
11. Illien S, Omran H, Mac Carter D, St.Cyr J. Ribose improves myocardial function and quality of life in congestive heart failure patients. J Mol Cell Cardiol 2001; 33:A173.
12. Vance R, Einzig S, Kreisler K, St.Cyr J. D-ribose maintains ejection fraction following aortic valve surgery. FASEB J 2000; 14:A419.

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