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Case Report

Heart conditioning as healthy strategy in management of aortic stenosis: A case report

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Abstract: Introduction: Heart conditioning can be utilized as a healthy strategy in the reversion of disease and ageing. In this sense, heart conditioning may benefit the aortic stenosis patients. Case presentation: We describe the case of an 82-year-old man with moderate to severe aortic stenosis (aortic valve area 1.01 cm^2 with peak pressure gradient 56.7mmHg) who refused valvular intervention. He was treated conservatively with antianginal drugs, and remote ischemic preconditioning as a healthy strategy was delivered once daily. To our surprise, 27 months later, follow-up transthoracic echocardiography showed an aortic valve area of 1.41 cm^2. His symptoms were dramatically relieved. Conclusions: This case indicates that heart conditioning as a healthy regimen is a valuable safe and effective adjunctive treatment in aortic stenosis patients, which could affect cardiac reverse remodeling and recovery as well as quality of life.

Keywords: aortic stenosis; heart conditioning; healthy strategy; case report

1. Introduction

Aortic stenosis represents the most prevalent form of valvular heart disease observed in clinical settings[1]. Transthoracic echocardiography is the diagnostic method of choice for evaluating aortic stenosis, facilitating the assessment of hemodynamic severity, valve morphology, and any associated valvular or ventricular dysfunction[2].

The rate at which hemodynamic changes occur in aortic stenosis varies and is often unpredictable. Generally, the progression of aortic stenosis is gradual, with symptoms frequently being nonspecific. Despite the extended asymptomatic phase associated with this condition, there are currently no available treatments that can prevent its progression or postpone the necessity for aortic valve replacement. Numerous efforts to establish the efficacy of various medical therapies have not yielded significant clinical benefits. For example, statin therapy has not demonstrated any clinical advantages in halting the progression of aortic stenosis[3].

In 1986, Murry et al. were the first to demonstrate the phenomenon of ischemic preconditioning in dogs [4]. They found that brief, repeated occlusions of the coronary artery lasting five min prior to a prolonged occlusion led to a significant reduction in the size of the infarct. This concept of ischemic preconditioning has since been thoroughly validated across various animal species and in human subjects[4–6]. It has been shown to provide protective benefits against postischemic contractile dysfunction, [7] cardiac arrhythmias induced by ischemia and reperfusion[8,9], apoptosis [10], and infarct injury [4–6]. Furthermore, ischemic preconditioning has been applied in clinical settings for patients with coronary artery

disease, resulting in improved outcomes during cardiac catheterization [11] and heart surgery [12].

Additionally, remote ischemic conditioning (RIC), which involves inducing mild ischemia and reperfusion in a distant organ, has also been found to confer protective effects on the heart. This noninvasive technique typically employs the intermittent inflation of a standard blood pressure cuff to 200 mmHg, with three to four cycles of five-min inflation followed by five-min reperfusion intervals [13]. In patients undergoing cardiac catheterization or heart surgery, RIC has been associated with reduced heart injury and a decrease in major adverse cardiovascular and cerebrovascular events[14–17]. Moreover, when administered daily for a duration of 28 days, RIC has demonstrated the ability to improve adverse left ventricular remodeling and enhance cardiovascular function in rat models following myocardial infarction [18].

Recent studies have indicated that heart conditioning can serve as a beneficial approach, aligned with the heterochronic parabiotic model, for reversing disease and aging [19]. In this context, heart conditioning may offer advantages for patients with aortic stenosis. We present a case of a patient with moderate to severe aortic stenosis who was treated with heart conditioning as healthy strategy.

2. Case presentation

A 74-year-old male patient, with no significant comorbidities, presented with a two-month history of dyspnea upon exertion and chest discomfort. He had a medical history of hypertensive heart disease and diabetes mellitus, which were being managed at another clinic. The patient reported no history of smoking or alcohol consumption. Written informed consent was obtained from the patient for publication of this case report and any accompanying images. This study was approved by the Ethic Committee of Jen Ai Hospital.

During the physical examination, the patient's body temperature was recorded at 37℃, with a pulse rate of 67 beats per min, a respiratory rate of 20 breaths per min, and a blood pressure of 134/75 mmHg. Auscultation revealed clear breath sounds and a regular heart rhythm, accompanied by a grade 2/6 systolic murmur noted at the left sternal border. The abdominal examination indicated a soft abdomen, and peripheral pulses were found to be intact. There was an absence of peripheral edema, and the neurological assessment yielded normal results. Laboratory tests, including a complete blood count and blood chemistry profile, returned normal results. Chest radiographs were also unremarkable. An electrocardiogram indicated sinus rhythm with nonspecific ST-T wave changes. Myocardial perfusion imaging revealed moderate ischemia in the anterior and inferior walls of the left ventricle. The patient was diagnosed with coronary artery disease presenting as stable angina pectoris, and his symptoms subsequently improved with treatment.

Subsequent follow-up of transthoracic echocardiography (**Table 1**) showed that patient had mild aortic stenosis three years later. Transthoracic echocardiography was performed using Acuson SC2000 (Siemens Inc, Germany) in the standard manner. 2 years ago, his aortic stenosis became critical with worsening symptoms.

Transthoracic echocardiography demonstrated moderate to severe aortic stenosis with aortic valve area of 1.01 cm^2, mean pressure gradient of 56.7mmHg, left atrial dilatation of 52mm, and good left ventricular systolic function, EF 68.8%(**Figure 1**, top). We advised surgical or transcatheter aortic valve replacement but patient strongly refused. We then continued current conservative drug therapy and RIC delivered once daily. In each RIC treatment, an automated healthy sphygmomanometer (Urion Co., Shenzhen, China) was used. A standard blood pressure cuff was applied to the upper arm of the patient, and inflated to a pressure of 200mmHg for 3 min, after which the cuff was deflated automatically. RIC treatment was performed by the patient himself once every day at home. A physician confirmed that our patient operated the RIC correctly in the first week.

To our surprise, 27 months later, follow-up transthoracic echocardiography showed an aortic valve area of 1.41 (**Figure 1**, bottom).His symptoms were dramatically relieved.

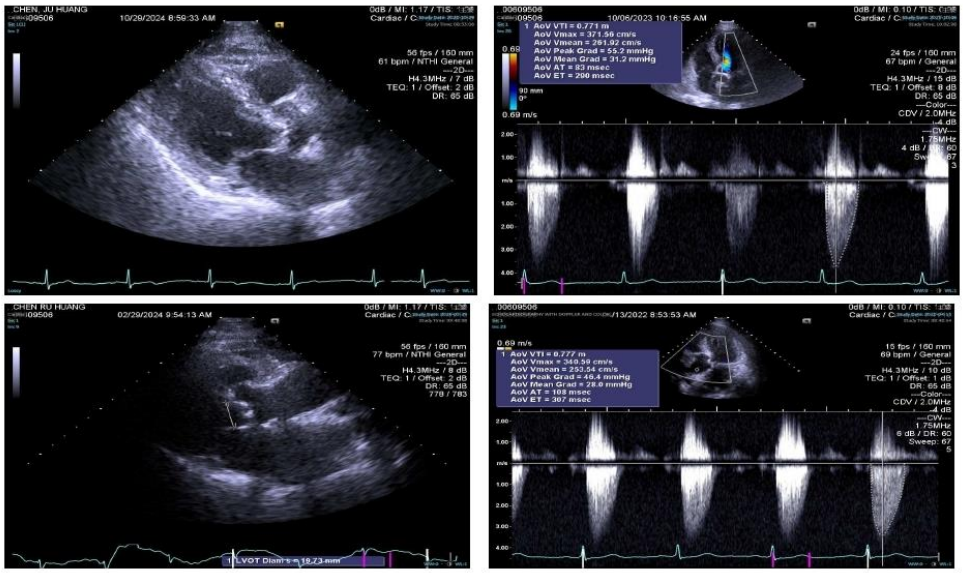

Figure 1. Two-dimensional and doppler echocardiography showing domed stenosis (left) and peak pressure gradient (right) of aortic valve before (top) and after (bottom) a 27-month duration of remote ischemic conditioning in our patient, respectively.

Table 1. Changes in echocardiographic parameters in our patient.

	AVA(cm^2)	Peak Pressure Gradient (mmHg)	LVDd (mm)	LVSd (mm)	LA (mm)	IVS (mm)	PW (mm)	EF(%)	AR
11 years ago			49	32	45	11	11	62%	mild
8 years ago	1.85	20.3	47.3	26.7	36.4	11	11	71%	mild-moderate
5 years ago	1.36	38.2	55.7	27	48.5	9.8	10.8	64.2%	moderate
2 years ago(RIC started)	1.01	56.7	44	27	52	10	10	68.8%	mild
1 year ago (RIC continued)	1.16	46.4	49	28	41	11	11	62%	mild
Present(RIC continued)	1.41	46	52	35	39	11	11	64%	mild

Abbreviations: AVA, aortic valve area; LA, left atrial dimension; LVDd, left ventricular end diastolic dimension; LVSd, left ventricular end systolic dimension; IVS, intraventricular septum; PW, posterior wall; EF, left ventricular ejection fraction; AR, aortic regurgitation; RIC, remote ischemic conditioning.

3. Discussion

This case demonstrates that a 27-month regimen of RIC treatment effectively reverses aortic stenosis in our patient without any negative side effects, supporting the broader application of heart conditioning in the daily routines of these individuals.

Ventricular remodelling refers to changes in the geometry, structure, and function of the heart. It is a primary mechanism in heart failure associated with decreased ejection fraction, disease progression, and clinical outcomes [20].Halting or reversing the remodelling process is a key focus in the treatment of heart failure. One study defines reverse remodelling as a greater than 15% increase in left ventricular ejection fraction (LVEF) or a 10% increase in LVEF accompanied by improvements in left ventricular end-systolic parameters over one year [21]. Another study shows that reductions in end-systolic and end-diastolic volumes are linked to reverse remodelling [22]. In this case, after 27 months of RIC treatment, significant improvements were observed, including reductions in left atrial size and left ventricular diastolic and systolic diameters. Furthermore, follow-up transthoracic echocardiography unexpectedly revealed an aortic valve area of 1.41 cm^2. This suggests that RIC treatment, as a beneficial strategy, promotes reverse remodelling, thereby contributing to the reversal of disease and ageing, consistent with the heterochronic parabiotic model.

Ischemic preconditioning was first identified in canines by Murry et al. in 1986.Remote ischemic conditioning (RIC), which involves brief ischemia and reperfusion of a distant organ, also offers myocardial protection[13]. The RIC protocol remains largely empirical; however, it generally involves the inflation of a blood pressure cuff to 200 mmHg for a duration of 3 to 5 min[13]. The adaptation of the heart to a preconditioned state through short, transient episodes of physiological myocardial ischemia represents a significant advancement in myocardial protection strategies.

Heart conditioning is considered as a highly appealing approach to achieving cardioprotection due to its safety and ease of implementation. RIC protocols typically involve the ischemia and reperfusion of the arm or leg, rather than direct coronary manipulation. Therefore, the existence of conditioning in humans could serve as a substantial motivation for developing methods or strategies aimed at maintaining a continuously conditioned and protected state, ideally on a regular and indefinite basis. In this context, RIC was conducted over an extended period of 27 months as part of a healthy regimen. The results indicated that heart conditioning, as healthy regimen, reverses aortic stenosis. Thus, heart conditioning contributes to the reversal of disease and aging, as demonstrated by reverse remodeling[19].

The findings of this study suggest that the implementation of RIC, which was conducted simply through the inflation of a blood pressure cuff that patients could operate independently, may serve as a viable self-care intervention for both inpatients and those receiving care at home. Additionally, patient adherence appears to be high, as RIC was performed only once daily, promoting overall health.

4. Conclusions

In summary, this case demonstrates that heart conditioning as a healthy regimen represents a valuable, safe, and effective complementary treatment for patients with aortic stenosis. It has the potential to influence cardiac reverse remodeling, recovery, and overall quality of life. The daily application of RIC over a period of 27 months as a health strategy has not been previously documented. Further randomized controlled trials involving a larger patient population are necessary to validate these findings and to investigate additional clinical outcomes.

Ethics approval: This study was approved by the Ethic Committee of Jen Ai Hospital, with JAHEC No.609506. Patient completed a written informed consent. This study was conducted in compliance with the ethical standards of the responsible institution on human subjects as well as with the Helsinki Declaration.

Conflict of interest: The authors declare no conflict of interest.

References

1. Carabello BA, Paulus WJ. Aortic stenosis. Lancet. 2009; 73:956–966.
2. Baumgartner H, Hung J, Bermejo J, et al. Recommendations on the echocardiographic assessment of aortic valve stenosis: A focused update from the European association of cardiovascular imaging and the American society of echocardiography. European Heart Journal—Cardiovascular Imaging. 2017; 18:254–275.
3. Chen KL, Two K, Dumesnil TG, et al. Effect of lipid lowering with rosuvastatin on progression of aortic stenosis: Results of the aortic stenosis progression observation: Measuring effects of rosuvastatin (ASTRONOMER) trial. Circulation. 2010; 121:306–314.
4. Murry CE, Jennings RB, Reimer KA. Preconditioning with ischemia: A delay of lethal cell injury in ischemic myocardium. Circulation. 1986; 74:1124–1136.
5. Sumeray MS, Yellon DM. Characterization and validation of a murine model of global ischemia-reperfusion injury. Molecular and Cellular Biochemistry. 1998; 186:61–68.
6. Schott RJ, Rohmann S, Braun ER, Schaper W. Ischemic preconditioning reduces infarct size in swine myocardium. Circulation Research. 1990; 66:1133–1142.
7. Cave AC, Hearse DJ. Ischemic preconditioning and contractile function: Studies with normothermic and hypothermic global ischemia. J. Mol. Cell.Cardiol. 1991; 24:1113–1123.
8. Shiki K, Hearse DJ. Preconditioning of ischemic myocardium: Reperfusion-induced arrhythmias. Am. J. Physiol. 1987; 253:H1470–1476.
9. Vegh A, Komori S, Szekeres L, Parratt JR. Antiarrhythmic effects of preconditioning in anesthetized dogs and rats. Cardiovas Research. 1992; 26:487–495.
10. Piot CA, Padmanaban D, Ursell PC, et al. Ischemic preconditioning decreases apoptosis in rat hearts in vivo. Circulation. 1997; 96:1598–1604.
11. Leslay WK, Beach D. Frequency and clinical significance of ischemic preconditioning during percutaneous coronary intervention. J. Am. Coll. Cardiol. 2003; 42:998–1003.
12. Walsh SR, Tang TY, Kullar P, et al. Ischemic preconditioning during cardiac surgery: Systemic review and meta-analysis of perioperative outcomes in randomized clinical trials. Eur. J.Cardiothorac. Surg. 2008; 34:985–994.
13. Heusch G, Botker HE, Przyklenk K, et al. Remote ischemic conditioning. J. Am. Coll. Cardiol. 2015; 65:177–195.
14. Thielmann M, Kottenberg E, Kleinbongard P, et al. Cardioprotective and prognostic effects of remote ischemic preconditioning in patient undergoing coronary artery bypass surgery: A single-centre randomized, double-blind, controlled trial. Lancet. 2013; 382:597–604.
15. Hoole SP, Heck PM, Sharples L, et al. Cardiac remote ischemic preconditioning in coronary stenting (CRISP) study: A prospective, randomized control trial. Circulation. 2009; 119:820–827.

16. Davies WR, Brown AJ, Watson W, et al. Remote ischemic preconditioning improves outcome at 6 years after elective percutaneous coronary intervention: The CRISP stent trial long-term follow-up. Circ. Cardiovasc. Interv. 2013; 6:246–251.
17. Crimi G, Pica S, Raineri C, et al. Remote ischemic postconditioning of the lower limb during primary percutaneous coronary intervention safely reduces enzymatic infarct size in anterior myocardial infarction: A randomized controlled trial. JACC Cardiovasc. Interv. 2013; 6:1055–1063.
18. Wei M, Xin P, Li S, et al. Repeated remote ischemic postconditioning protects against adverse left ventricular remodeling and improves survival in a rat model of myocardial infarction. Circulation Research. 2011; 108:1220–1225.
19. Lee AYS. Heart conditioning and heterchronic parabiotic models as healthy strategies. Medicine, Environmental Science. 2023; 5:6.
20. Aimo A, Gaggin HK, Bavison A, et al. Imaging, biomarker and clinical predictors of cardiac remodeling in heart failure with reduced ejection fraction. JACC:Heart Failure. 2019; 7(9):782–794.
21. Lupon J, Gaggin HK, De Antonio M, et al. Biomarker-assist score for reverse remodeling prediction in heart failure: The ST2-R2 score. Int. J.Cardiol. 2015; 84:337–343.
22. Mathias A, Moss AJ, McNitt S, et al. Clinical implications of complete left-sided reverse remodeling with cardiac resynchronization therapy: A MADIT-CRT substudy. J. Am. Coll.Cardiol. 2016; 68:1268–1276.