PRESCRIBING PHYSICAL ACTIVITY FOR THE PREVENTION AND TREATMENT OF HYPERTENSION IN PATIENTS WITH AORTIC COARCTATION - A REVIEW

Roselien Buys

Postdoctoral Researcher, Department of Rehabilitation Sciences, Catholic University of Leuven, Belgium

Disclosure: No potential conflict of interest.
Received: 02.06.2013 **Accepted:** 29.07.2013
Citation: EMJ Cardiol. 2013;1:92-95.

ABSTRACT

Patients who have been treated for aortic coarctation (CoA) have increased late cardiovascular morbidity and mortality, which is partly due to the development of arterial hypertension occurring in up to 70% of patients. Primary prevention measures are important in order to delay or prevent the onset of hypertension as much as possible. So far, hypertension management in this population has mainly focused on the early detection of hypertension and the antihypertensive drug treatment. Even though a physically active lifestyle is recognised as a cornerstone in the prevention, treatment, and management of hypertension, exercise prescription in this context for patients with CoA is not common practice. Studies on the safety and efficacy of sports and exercise training in patients with CoA, both before and after repair, are lacking. However, decreasing blood pressure can be obtained through exercise training, in both healthy subjects and patients with hypertension. Moreover, patients with CoA are not restricted from all physical activities. Therefore, it seems that endurance exercise, supplemented by resistance exercise without isometric exercises on most days of the week, should be prescribed, but only after thorough and regularly repeated medical check-ups, including cardiopulmonary exercise testing.

Keywords: Aortic coarctation, blood pressure, hypertension, exercise, physical activity.

INTRODUCTION

Coarctation of the aorta, or CoA, is a congenital condition in which the aorta narrows in the area where the ductus arteriosus inserts. It occurs in approximately 0.34 per 1,000 live births.[1] When the narrowing has haemodynamic repercussions, surgical or percutaneous treatment is required. Patients who have been treated for CoA, require lifelong follow-up because of increased late cardiovascular morbidity and mortality, which is mainly due to the development of arterial hypertension and the occurrence of vascular complications.[2-7]

HYPERTENSION IN PATIENTS WITH COA

The late development of hypertension is common in patients with CoA, even after excellent repair.[8] Recently, Caniffe et al.[9] summarised the prevalence of hypertension in patients with CoA and reported the median prevalence to be 32.5%, which is based on studies reporting the prevalence between 25% and 68%.[9] The patterns for late hypertension have their origins in childhood, with preterm changes of the vascular bed that are both congenital and acquired.[8] These changes are demonstrated by endothelial dysfunction, arterial stiffness, a reduced arterial response to glyceryl trinitrate, increased carotid intima-media thickness, higher forearm pulse wave velocities, and by abnormal spontaneous baroreceptor sensitivity.[9] Moreover, renal and neurohormonal control mechanisms may also contribute to the development of hypertension.[9]

Even though the underlying mechanisms that lead to hypertension need to be further elucidated, it is important that all post-coarctation patients with hypertension are quickly identified and

managed in order to minimise their risk of hypertension-related complications.[9] In this light, the usefulness of exercise testing as a predictive tool for future hypertension has been reported in patients who underwent coarctation repair of the aorta.[10] Furthermore, it is suggested that aortic arch geometry can identify patients post-coarctation repair who are at a higher risk of developing hypertension.[11]

It is important to emphasise primary prevention measures in order to delay or prevent the onset of hypertension as much as possible.[10] So far, hypertension management in this population has mainly focused on early detection of hypertension and antihypertensive drug treatment, whereas lifestyle measures are less often investigated. However, a physically active lifestyle is recognised as a cornerstone for the prevention, treatment and management of hypertension.[12]

Beneficial Effects of Physical Activity on Blood Pressure

Previous epidemiological studies have demonstrated that physical activity and cardiorespiratory fitness are independent predictors of incident hypertension.[13-17] Therefore, people should be physically active by participating in regular physical activity and maintain/improve their fitness for the primary prevention of hypertension, as well as cardiovascular diseases in general.[18] This healthy lifestyle, with the primary prevention of atherosclerotic disease, should begin in childhood.[19]

The beneficial effects of exercise training on blood pressure have been shown both in normotensive and hypertensive persons.[20-22] It seems a decrease in blood pressure can be obtained through a reduction of vascular resistance, in which the sympathetic nervous system and the renin-angiotensin system appears to be involved, and favourably affects concomitant cardiovascular risk factors.[20]

When the prevention or management of hypertension is aimed in subjects with cardiovascular risk factors, endurance exercise, supplemented by resistance exercise on most - preferably all - days of the week, should be prescribed.[23]

Benefits of Physical Activity for Blood Pressure Improvement in Patients with CoA

There is an urgent need for well-designed studies investigating the effect of exercise-based interventions on exercise capacity, cardiovascular risk factors, quality of life, and long-term outcome in patients with coarctation of the aorta.

However, it is not unlikely that findings from studies on healthy and hypertensive persons can be extended towards patients with CoA. Exercise could possibly ameliorate endothelial function and the quality of the vascular bed in these patients and, therefore, reduce blood pressure and its response to exercise. This might eventually reduce the incidence of high blood pressure.

PHYSICAL ACTIVITY FOR PATIENTS WITH COA

Patients with CoA are more prone to adopt a sedentary lifestyle because of fear or overprotection by the parents and the environment.[24] Indeed, a recent study by our group showed that adult patients with CoA are less active than the general population, and less active than recommended.[25] However, the 2010 guidelines of the European Society of Cardiology states: "Patients without residual obstruction who are normotensive at rest and with exercise, can usually lead normally active lives without restriction, except for extensive static sports at competition level. Patients with arterial hypertension, residual obstruction or other complications should avoid heavy isometric exercises, in proportion to the severity of their problems."[3]

Hence, patients with CoA should comply with public health recommendations. Children are encouraged to participate every day in 60 minutes of moderate-to-vigorous physical activity that is developmentally appropriate as well as enjoyable, and involves a variety of activities. Moreover, they should perform less than 2 hours per day of sedentary activities.[26] For adults, it is recommended that healthy people should choose enjoyable physical activities, which fit into their daily routine, preferably for 30–45 minutes, 4-5 times a week, in order to prevent or delay the onset of cardiovascular disease.[27]

With a lack of studies on sports and exercise training in patients with CoA both before and after repair, it is only possible to extrapolate from the recommendations for arterial hypertension. As stated above, endurance exercise supplemented by resistance exercise, should be prescribed when prevention or management of hypertension is aimed.[23] Nevertheless, in patients with CoA, one has to be cautious with the

prescription of resistance programmes with isometric exercises.

The participation of patients with aortic coarctation in exercise programmes and sport activities always has to be judged individually, and needs to be based on and evaluated by regular medical surveillance, including cardiopulmonary exercise testing in order to rule out an abnormal blood pressure response to exercise. Medical exercise prescription and supervision are strongly recommended.[28] This way, the nature of the original coarctation, the type of coarctation repair, the aortic arch anatomy, rest gradient, presence of a bicuspid aortic valve, etc., is taken into account.

CONCLUSIONS

It is recommended that specialised health professionals should more actively counsel their patients with CoA to be physically active, by having them participate in regular physical activity such as walking, jogging, bicycling, swimming, and playing sports, as well as to improve their fitness both for the primary prevention and the treatment of hypertension. Based on evidence in healthy subjects and patients with hypertension, it seems that endurance exercise, supplemented by resistance exercise without isometric exercises on most days of the week, should be prescribed, but only after thorough and regularly repeated medical check-ups, including cardiopulmonary exercise testing.

REFERENCES

1. van der Linde D, Konings EE, Slager MA, et al. Birth prevalence of congenital heart disease worldwide: a systematic review and meta-analysis. J Am Coll Cardiol. 2011;58(21):2241-7.

2. Luijendijk P, Bouma BJ, Vriend JW, et al. Usefulness of exercise-induced hypertension as predictor of chronic hypertension in adults after operative therapy for aortic isthmic coarctation in childhood. Am J Cardiol. 2011;108(3):435-9.

3. Baumgartner H, Bonhoeffer P, De Groot NM, et al. ESC guidelines for the management of grown-up congenital heart disease. Eur Heart J. 2010;31(23):2915-57.

4. Hager A, Kanz S, Kaemmerer H, et al. Coarctation Long-term Assessment (COALA): significance of arterial hypertension in a cohort of 404 patients up to 27 years after surgical repair of isolated coarctation of the aorta, even in the absence of restenosis and prosthetic material. J Thorac Cardiovasc Surg. 2007;134(4):738-45.

5. Vriend JW, Mulder BJ. Late complications in patients after repair of aortic coarctation: implications for management. Int J Cardiol. 2005;101(3):399-406.

6. Swan L, Kraidly M, Vonder Muhll I, et al. Surveillance of cardiovascular risk in the normotensive patient with repaired aortic coarctation. Int J Cardiol. 2010;139(3):283-8.

7. Meyer AA, Joharchi MS, Kundt G, et al. Predicting the risk of early atherosclerotic disease development in children after repair of aortic coarctation. Eur Heart J. 2005;26(6):617-22.

8. Hager A. Hypertension in aortic coarctation. Minerva Cardioangiol. 2009;57(6):733-42.

9. Canniffe C, Ou P, Walsh K, et al. Hypertension after repair of aortic coarctation - A systematic review. Int J Cardiol. 2012;epub ahead of print. doi:10.1016/j.ijcard.2012.09.084.

10. Buys R, Van De Bruaene A, Müller J, et al. Usefulness of cardiopulmonary exercise testing to predict the development of arterial hypertension in adult patients with repaired isolated coarctation of the aorta. Int J Cardiol. 2013; epub ahead of print. doi:10.1016/j.ijcard.2013.01.171.

11. Ou P, Celermajer DS, Mousseaux E, et al. Vascular remodelling after "successful" repair of coarctation. J Am Coll Cardiol. 2007;49(8):883-90.

12. Cornelissen V, Fagard R. "Hypertension", Saxton J. (Ed.), Exercise and chronic disease: an evidence-based approach (2011), United States of America: Taylor and Francis Books, Chapter 3.

13. Blair SN, Goodyear NN, Gibbons LW, et al. Physical fitness and incidence of hypertension in healthy normotensive men and women. JAMA. 1984;252(4):487–90.

14. Chase NL, Sui X, Lee DC, et al. The association of cardiorespiratory fitness and physical activity with incidence of hypertension in men. Am J Hypertens. 2009;22(4):417–24.

15. Paffenbarger RS Jr, Jung DL, Leung RW, et al. Physical activity and hypertension: an epidemiological view. Ann Med. 1991;23(3):319–27.

16. Paffenbarger RS Jr, Lee IM. Intensity of physical activity related to incidence of hypertension and all-cause mortality: an epidemiological view. Blood Press Monit. 1997;2(3):115–23.

17. Pereira MA, Folsom AR, McGovern PG, et al. Physical activity and incident hypertension in black and white adults: the Atherosclerosis Risk in Communities Study. Prev Med. 1999;28(3):304–12.

18. Vanhees L, De Sutter J, Geladas N, et al. Importance of characteristics and modalities of physical activity and exercise in the management of cardiovascular health within the general population. Recommendations from the EACPR (Part I). Eur J Cardiovasc Prev Rehabil. 2012;19(4):670-86.

19. Kavey RE, Daniels SR, Lauer RM, et al. American Heart Association guidelines for primary prevention of atherosclerotic cardiovascular disease beginning in childhood. Circulation. 2003;107(11):1562–6.

20. Cornelissen VA, Fagard RH. Effects of endurance training on blood pressure, blood pressure-regulating mechanisms, and cardiovascular risk factors. Hypertension. 2005;46(4):667–75.

21. Cornelissen VA, Fagard RH, Coeckelberghs E, et al. Impact of resistance training on blood pressure and other cardiovascular risk factors: a meta-analysis of randomized, controlled trials. Hypertension. 2011;58(5):950-8.

22. Cornelissen VA, Smart NA. Exercise training for blood pressure: a systematic review and meta-analysis. J Am Heart Assoc. 2013;2(1):e004473.

23. Vanhees L, Geladas N, Hansen D, et al.; for the EACPR writing group. Importance of characteristics and modalities of physical activity and exercise in the management of cardiovascular health in individuals with cardiovascular risk factors (Part II). Eur J Prev Cardiol.

2012;19(5):1005-33.

24. Reybrouck T, Mertens L. Physical performance and physical activity in grown-up congenital heart disease. Eur J Cardiovasc Prev Rehabil. 2005;12(5):498-502.

25. Buys R, Budts W, Delecluse C, et al. Exercise Capacity, Physical Activity, and Obesity in Adults With Repaired Aortic Coarctation. Journal of Cardiovascular Nursing. 2013;28(1):66-73.

26. Takken T, Giardini A, Reybrouck T, et al. Recommendations for physical activity, recreation sport and exercise training in pediatric patients with congenital heart disease: a report from the Exercise, Basic & Translational Research Section of the European Association of Cardiovascular Prevention and Rehabilitation, the European Congenital Heart and Lung Exercise Group, and the Association for European Paediatric Cardiology. Eur J Cardiovasc Prev Rehabil. 2012;19(5):1034-65.

27. Graham I, Atar D, Borch-Johnsen K, et al. European guidelines on cardiovascular disease prevention in clinical practice: executive summary. Fourth Joint Task Force of the European Society of Cardiology and other Societies on Cardiovascular Disease Prevention in Clinical Practice (Constituted by representatives of nine societies and by invited experts). Eur Heart J. 2007;28(19):2375–414.

28. Vanhees L, Rauch B, Piepoli M, et al; on behalf of the writing group of the EACPR. Importance of characteristics and modalities of physical activity and exercise in the management of cardiovascular health in individuals with cardiovascular disease (part III). Eur J Prev Cardiol. 2012;19(6):1333-56.