RESISTANCE EXERCISE AND HYPERTENSION

Dr.Lim Boon Hooi,
PhD,
Doctor Degree In Sport Science,
University Of Malaya.
Email: lboonhooi@um.edu.my

Introduction

Hypertension is a “Silent Killer”, most of the time, it has no obvious symptoms to indicate that something’s wrong and many people are unaware that they have the condition. 30-45% of adults around the world are affected by hypertension (Mancia et al., 2013) and is an important cardiovascular risk factor (Cornelissen, Fagard, Coeckelberghs, & Vanhees, 2011; Cornelissen & Smart, 2013; Mancia et al., 2013) directly related to cardiovascular morbidity and mortality (Cornelissen et al., 2011).

Lifestyle changes are the first line of therapy for hypertensive individual and exercise programs have been widely encouraged (Mancia et al., 2013). Resistance exercise has been recommended as part of the therapeutic approach in individual with hypertension (Pescatello et al., 2004). Studies have shown that resistance exercise reduces blood pressure (BP) to levels below resting values (Mota et al., 2009), although this is not a universal finding (Roltsch, Mendez, Wilund, & Hagberg, 2001). Considering that the incidence of adverse side effects (real or perceived) can be high with some antihypertensive drugs (Grégoire et al., 2001) and may ultimately contribute to low rates of drug compliance or adherence, lifestyle interventions should be given serious consideration as valuable modalities for individual with hypertension to manage their BP and reduce their reliance on antihypertensive medications (James et al., 2014). Importantly, successful implementation of lifestyle modifications, including physical activity, often requires adoption of strategies to maintain behavior adherence (Hackam et al., 2013).

The traditional objective of clinical practice has been to achieve a resting BP target of B140/90 mmHg (Arguedas et al., 2009). Primary hypertension, a resting BP >140 mm Hg systolic and (or) >90 mm Hg diastolic, remains one of the most prevalent modifiable risk factors for cardiovascular disease (James et al., 2014).

Benefits of Resistance Exercise on Blood Pressure

Benefits on resistance exercise are acute reductions in ambulatory BP have been reported in hypertensive patients (Melo et al., 2006). Although some meta-analyses demonstrate that resistance training is associated with a reduction in resting BP of 1.8–3.5/ 3.2 mm Hg (Cornelissen et al., 2011; Cornelissen & Smart 2013), this observation is not universal. Recently, a more stringent meta-analysis of high-quality trial evidence reported that resistance training had no effect on systolic BP and smaller overall reductions in diastolic BP (–2.2 mm Hg) (Rossi et al., 2013). The effects of resistance training do appear to be more robust in prehypertension patients (–4.3–4.7/–3.2–3.8 mm Hg) and following isometric resistance training (–10.9–11.8/–5.8–6.2mmHg) (Cornelissen et al., 2011; Cornelissen & Smart 2013).

In general, greater evidence is required to substantiate a larger role for resistance exercise in the management of BP (Eckell et al., 2013). The current level of evidence does suggest that resistance exercise can be performed safely without risk of increasing BP or adverse events (Hackam et al., 2013; Rossi et al., 2013).

Moreover, the clinical impact of modest reductions in BP with exercise training should not be underestimated. A 5 mm Hg reduction in systolic BP is expected to translate into 14% and 9% reduction in stroke and coronary artery disease mortality, respectively (Chobanian et al., 2003). Furthermore, the beneficial effects of endurance and resistance exercise training on additional cardiovascular disease risk factors (e.g., obesity, insulin resistance, dyslipidemia, depression (Fletcher et al., 2001)) can improve cumulative patient risk profiles.

Precautions of Resistance Exercise in Hypertension Individual

It is recommended that all individuals complete appropriate screening prior to commencing an exercise program (Physical Activity Readiness Questionnaire (PAR-Q or PAR-Q+; available for download at www.csep.ca)). A recent systematic review indicates exercise in individual with hypertension (<160/90 mm Hg) is relatively safe (Thomas et al., 2011). Those wishing to increase their physical activity level should complete the Electronic Physical Activity Readiness Medical Examination (ePARmed-X) or Physician Clearance Form and seek guidance from their clinician and (or) qualified exercise professional (Bredin et al., 2013; Thomas et al., 2011). Exercise is generally contraindicated in untreated or uncontrolled hypertensive individual with resting BP >160–180/105–110 mm Hg (Pescatello

et al., 2004), in addition to standard absolute and relative contraindications for resistance exercise related to the presence of further comorbidities (Fletcher et al., 2001; Williams et al., 2007).

Do not continue to lift a weight when you feel exhausted. The intensity of the last few repetitions will be close to your maximum. Also, the rise in your BP may be too great. Also, avoid holding your breath when lifting. This can cause large changes in blood pressure. That change may increase the risk of passing out or developing abnormal heart rhythms (Pescatello et al., 2015).

Intensive isometric exercise such as heavy weight lifting can have a marked pressor effect and should be avoided (Mancia et al., 2013). If hypertension is poorly controlled, heavy physical exercise as well as maximal exercise testing should be discouraged or postponed until appropriate drug treatment has been instituted and blood pressure lowered. When exercising, it appears prudent to maintain systolic blood pressures at ≤220 mmHg and/or diastolic blood pressures ≤105 mmHg (Cornelissen et al., 2005).

The β-blockers and diuretics may adversely affect thermoregulatory function and cause hypoglycemia in some individuals. In these situations, educate individual with hypertension about the sign and symptoms of heat intolerance and hypoglycemia, and the precautions that should be taken to avoid these situations (Cornelissen et al., 2005). The antihypertensive medications such as calcium channel blockers, α-blockers and vasodilators may lead to sudden reductions in post-exercise blood pressure. Extend and monitor the cool-down period carefully in these situations (Cornelissen et al., 2005).

Also, the β-blockers, particularly the non-selective types, may reduce sub-maximal and maximal exercise capacity primarily in individual without myocardial ischemia. Consider using perceived exertion to monitor exercise intensity in these individuals (Cornelissen et al., 2005). Individual with hypertension should be informed about the nature of cardiac prodromal symptoms e.g. shortness of breath, dizziness, chest discomfort or palpitation and seek prompt medical care if such symptoms develop.

Recommendations and Evaluation of Resistance Exercise Programs for Individual with Hypertension

The Centers for Disease Control and Prevention, the U.S. Department of Health and Human Services, and the American College of Sports Medicine all recommend twice-a-week muscle strengthening exercise (Pescatello et al., 2015). Research indicates that moderate-intensity resistance training improves blood pressure. When you lift an object, your blood

pressure rises based on how many muscles you use and how hard it is to lift it. For instance, lifting with your legs and back or lifting very heavy weights will increase your blood pressure more than lifting with your arms only or lifting light weights. As your strength increases, your blood pressure will be lower when lifting the same weight compared to when you started. Follow the FITT principal when creating a resistance exercise program (Pescatello et al., 2015).

- **Frequency** -Do resistance exercise twice to thrice weekly on nonconsecutive days (Cornelissen et al., 2005)
- **Intensity** -Exercise at a moderate level. If you can lift a weight ten to 15 times, you've achieved moderate intensity. You get to high intensity when you can lift a weight only eight to ten times. Remember, you aren't training to be a weight lifter. Your goal is to improve your strength and muscle endurance so your daily activities will be less stressful. At such, Resistance exercise should be at moderate intensity (Cornelissen et al., 2005), which could be expressed as 50-70% of 1-repetition maximum (1-RM– maximum amount of weight one can lift in a single repetition for a given exercise).
- **Time** -This will depend on the number of exercises you do. Each session of resistance exercise should minimally include 8–10 exercises and should consist of at least 1 set of 8–12 repetitions per exercise (Cornelissen et al., 2005).
- **Type** -Exercise all major muscle groups using either free weights or a machine. There is no difference between the two methods. The same exercises at home using lighter weights, resistance bands, or body weight as the resistance, like push-ups or sit-ups. Resistance exercise performed should be alternating between upper- body and lower-body works to allow for adequate rest between exercises. Some examples of resistance exercise include chest press, shoulder press, triceps extension, biceps curl, pull-down (upper back), lower-back extension, abdominal crunch/curl-up, quadriceps extension or leg press, leg curls (hamstrings), and calf raise (William et al., 2007).

Most guidelines recommend a noncompeting adjunct role for resistance exercise, incorporating 1–2 set(s) of 10–15 repetitions for each major muscle group (8–10 exercises) on 2–3 days per week (Brook et al., 2013; Pescatello et al., 2004; Williams et al., 2007). Available studies demonstrate that a single session of resistance exercise can produce PEH (Gomes Anunciação & Doederlein Polito, 2011), even at low-intensities (Melo et al., 2006).

The Brazilian Guidelines on Hypertension 2010 recommend that hypertensive individual should avoid resistance exercise with repetitions until concentric failure (UF) in order to curb increases in BP during exercise. However a study observed that in normotensive adult women, UF resulted in a drop in BP on awakening, suggesting that this prescription may carry post exercise cardiovascular benefits for adult women (De Souza et al., 2013).

The Brazilian Guidelines on Hypertension (2010) include in their recommendations that hypertensive individual should not perform UF, in order to avoid the pronounced increases in systolic BP that occur during resistance exercise. In support, a previous study found that interruption of resistance exercise at this point can reduce increases in systolic BP during resistance exercise by 25 mmHg compared to UF (Gomides, Nery, Júnior, Tinucci, & Forjaz, 2007). Taken together these results indicate that avoiding fatigue during resistance exercise may be a useful way for hypertensive individual to prevent an increase in cardiovascular risk.

Designing a resistance exercise, there is a need and scope of pre-exercise evaluation of the cardiovascular status will depend on the extent of the envisaged exercise and on the hypertension individual's symptoms and signs, total cardiovascular risk and associated clinical conditions (Mancia et al., 2013). The risk of cardiovascular disease in individual with hypertension is determined not only by the level of blood pressure, but also by the presence or absence of target organ damage and other risk factors such as smoking, dyslipidemia and diabetes. These factors independently modify the risk for subsequent cardiovascular disease, and their presence or absence is determined during the routine evaluation of individual with hypertension (i.e., history, physical examination, and/or laboratory tests).

High-intensity resistance training should not be initiated for persons without prior exposure to more moderate resistance exercise independently of age, health status, or fitness level (William et al., 2007). Therefore, individual with hypertension should consult a primary care practitioner prior to any substantive increase in physical activity, particularly vigorous-intensity activity.

A New Invention of Isometric Exercise for Individual with Hypertension - 360° TitaniUM Core Strength Exercise

An isometric or static contraction is defined as a sustained muscle contraction (i.e. increase in tension) with no change in length of the involved muscle group (Mitcheel & Wildenthal, 1974). The largest isometric training reductions in resting BP have been demonstrated in hypertensive patients (Peters et al., 2006). In an randomized controlled trial

of older patients with difficult-to control medicated hypertension, Taylor and colleagues (2003) reported that 10 weeks of isometric handgrip training reduced systolic BP and mean arterial pressure in concert with significant reductions in the low-frequency spectra of systolic BP variability, a marker of baroreflex-mediated peripheral sympathetic modulation (Guzzetti et al., 1994).

However, given that a few studies related to the isometric exercise training protocols to the individual with hypertension only utilized handgrip or leg contractions resistance exercises. We would like to propose a new A New Invention of Isometric Exercise for Individual with Hypertension - 360° TitaniUM Core Strength Exercise**.** The clinical significance of the 360° TitaniUM Core Strength Exercise as a time-efficient and effective training modality to reduce BP, warrant further study. 360° TitaniUM Core Strength Exercise® (Figure 1) is a new sequence of exercises to strengthen the core region muscles. It is easy to remember with no specific equipment needed to carry out this exercise. It is suitable for all athletes and non-athletes. The structured sequence of exercises would enable the practitioners to experience greater efficiency of movement; improved body control and balance; increased power output from both the core musculature and peripheral muscles such as the shoulders, arms and legs; reduced risk of injury (the core muscles act as shock absorbers for jumps and rebounds etc.).

Figure 1: 360° TitaniUM Core Strength Exercise®

References:

1. Arguedas, J, A., Perez, M. I., & Wright, J. M. (2009). Treatment blood pressure targets for hypertension. Cochrane Database Syst Rev. (3):CD004349.

2. Bredin, S.S., Gledhill, N., Jamnik, V.K., and Warburton, D.E. (2013). PAR-Q+ and ePARmed-X+: new risk stratification and physical activity clearance strategy for physicians and patients alike. Can. Fam. Physician. 59(3): 273–277. PMID: 23486800.

3. Brook, R. D., Appel, L. J., Rubenfire, M., Ogedegbe, G., Bisognano, J. D., Elliott, W. J. (2013). Beyond medications and diet: alternative approaches to lowering blood pressure: a scientific statement from the American heart association. Hypertension, 61(6): 1360–1383. doi:10.1161/HYP.0b013e318293645f. PMID: 23608661.

4. Cornelissen, V. A., Fagard, R. H. (2005). Effects of endurance training on blood pressure, blood pressure-regulating mechanisms, and cardiovascular risk factors. Hypertension. 46:667–75.

5. Chobanian, A.V., Bakris, G.L., Black, H.R., Cushman, W.C., Green, L.A., Izzo, J.L., Jr. (2003).The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA, 289(19): 2560–2572. doi:10.1001/jama.289.19.2560. PMID: 12748199.

6. Cornelissen, V. A., Fagard, R. H., Coeckelberghs, E., & Vanhees, L. (2011). Impact of resistance training on blood pressure and other cardiovascular risk factors: a meta-analysis of randomized, controlled trials. Hypertension, 58 (5), 950–958. http://doi.org/10.1161/HYPERTENSIONAH A.111.177071

7. Cornelissen, V. A., & Smart, N. A. (2013). Exercise training for blood pressure: a systematic review and meta-analysis. J o u r n a l o f t h e A m e r i c a n H e a r t A s s o c i a t i o n , 2 (1), e004473. http://doi.org/10.1161/JAHA.112.004473

8. De Souza, J. C., Tibana, R. A., Cavaglieri, C. R., Vieira, D. C. L., De Sousa, N. M. F., Mendes, F. A. D. S., Prestes, J. (2013). Resistance exercise leading to failure versus not to failure: effects on cardiovascular control. BMC C a r d i o v a s c u l a r D i s o r d e r s, 1 3, 105. http://doi.org/10.1186/1471-2261-13-105.

9. Eckell, R. H., Jakicic, J. M., Ard, J. D., Miller, N.H., Hubbard, V.S., Nonas, C.A. (2013). 2013 AHA/ACC Guideline on Lifestyle Management to Reduce Cardiovascular Risk: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J. Am. Coll. Cardiol. [Epub ahead of print.] doi:10.1016/j.jacc.2013.11.003. PMID: 24239922.

10. Fletcher, G. F., Balady, G. J., Amsterdam, E. A., Chaitman, B., Eckel, R., Fleg, J. (2001). Exercise standards for testing and training: a statement for healthcare professionals from the American Heart Association. Circulation, 104(14): 1694–1740. doi:10.1161/hc3901.095960. PMID: 11581152.

11. GomesAnunciação, P. & DoederleinPolito, M. (2011). A review on post-exercise hypotension in hypertensive individuals. Arq. Bras. Cardiol. 96(5): 100–109. doi:10.1590/S0066-782X2011005000025. PMID: 21359479.

12. Gomides, R. S., Nery, S. S., Júnior, D. S., Tinucci, T., & Forjaz, C. L. M. (2007). Pressão arterial durante o exercício resistido de diferentes intensidades em indivíduos hipertensos. C o l e ç ã o P e s q u i s a e m E d u c a ç ã o F í s i c a , 6 (1), 435–442

13. Grégoire, J.P., Moisan, J., Guibert, R., Ciampi, A., Milot, A., Côté, I., and Gaudet, M. (2001). Tolerability of antihypertensive drugs in a communitybased setting. Clin. Ther. 23(5): 715–726. doi: 10.1016/S0149-2918(01)80021-7. PMID: 11394730.

14. Guzzetti, S., Dassi, S., & Balsama, M. (1994). Altered dynamics of the circadian relationship between systemic arterial pressure and cardiac sympathetic drive early on in mild hypertension. Clin Sci (Lond). 86:209–15.

15. Hackam, D.G., Quinn, R.R., Ravani, P., Rabi, D.M., Dasgupta, K., Daskalopoulou, S.S. (2013). The 2013 Canadian hypertension education program recommendations

for blood pressure measurement, diagnosis, assessment of risk, prevention, and treatment of hypertension. Can.J.Cardiol. 29(5): 528–542. doi:10.1016/j.cjca.2013.01.005. PMID: 23541660.

16. James, P.A., Oparil, S., Carter, B.L., Cushman, W.C., Dennison-Himmelfarb, C., Handler, J. (2014). Evidence-basedguidelineforthemanagementof high blood pressure in adults. Report from the panel members appointed to the Eighth Joint Nation Committee (JNC8).JAMA, 311(5):507–520.doi:10.1001/ jama.2013.284427. PMID: 24352797.

17. Mancia, G., Fagard, R., Narkiewicz, K., Redon, J., Zanchetti, A., Böhm, M.,Wood, D. A. (2013). ESH/ESC guidelines for the management of arterial hypertension: the Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). European Heart Journal, 34 (28), 2159–2219. http://doi.org/10.1093/eurheartj/eht151

18. Melo, C.M., Alencar Filho, A.C., Tinucci, T., Mion, D., Jr., and Forjaz, C.L. (2006). Postexercise hypotension induced by low-intensity resistance exercise in hypertensive women receiving captopril. Blood Press. Monit. 11(4): 183–189. doi:10.1097/01.mbp.0000218000.42710.91. PMID: 16810028.

19. Mitchell, J.H., & Wildenthal, K. (1974). Static (isometric) exercise and the heart: physiological and clinical considerations. Annu Rev Med. 25:369–81.

20. Mota, M. R., Pardono, E., Lima, L. C. J., Arsa, G., Bottaro, M., Campbell, C. S. G., & Simões, H. G. (2009). Effects of treadmill running and resistance exercises on lowering blood pressure during the daily work of hypertensive subjects. Journal of Strength and Conditioning Research, 23 (8), 2331–2338. http://doi.org/10.1519/JSC.0b013e3181bac418

21. Pescatello, L. S., Franklin, B. A., Fagard, R., Farquhar, W. B., Kelley, G. A., & Ray, C. A. (2004). American College of Sports Medicine position stand. Exercise and hypertension. Medicine and Science in Sports and Exercise, 36 (3), 533–553.

22. Pescatello, L. S., MacDonald, H. V., Ash, D. I. (2015). Assessing the existing professional exercise recommendations for hypertension: A review and recommendations for future research priorities. Mayo Clin. Proc : 90 (6): 801-812.

23. Peters, P.G,, Alessio, H.M., & Hagerman, A.E. (2006). Short-term isometric exercise reduces systolic blood pressure in hypertensive adults: possible role of reactive oxygen species. Int J Cardiol. 2006; 110:199–205.

24. Roltsch, M. H., Mendez, T., Wilund, K. R., & Hagberg, J. M. (2001). Acute resistive exercise does not affect ambulatory blood pressure in young men and women. Medicine and Science in Sports and Exercise, 33 (6), 881–886.

25. Rossi, A.M., Moullec, G., Lavoie, K.L., Gour-Provençal, G., and Bacon, S.L. (2013). The evolution of a Canadian Hypertension Education Program recommendation: The impact of resistance training on resting blood pressure in adults as an example. Can. J. Cardiol. 29(5): 622–627. doi:10.1016/j.cjca.2013.02.010. PMID: 23541664.
26. Taylor, A.C., McCartney, N., & Kamath, M.V. (2003). Isometric training lowers resting blood pressure and modulates autonomic control. Med Sci Sports Exerc. 2003; 35:251–6.
27. Thomas, S. G., Goodman, J. M., & Burr, J. F. (2011). Evidence-based risk assessment and recommendations for physical activity clearance: established cardiovascular disease. Appl. Physiol. Nutr. Metab. 36(S1): S190–S213. doi: 10.1139/h11050. PMID: 21800942.
28. Williams, M. A., Haskell, W. L., Ades, P. A., Amsterdam, E. A., Bittner, V., Franklin, B. A. (2007). Resistance exercise in individuals with and without cardiovascular disease: 2007 update: a scientific statement from the American Heart Association Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism. Circulation, 116(5): 572–584. Doi: 10. 1161/CIRCULATIONAHA.107.185214. PM