Physical exercise and cardiovascular therapy

Physical exercise as therapeutic option in arterial hypertension

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## Initiation of antihypertensive treatment

**2007 ESH ESC Hypertension Guidelines**  
**J Hypertens 2007;25:1105–1187**

<table>
<thead>
<tr>
<th>Blood pressure (mmHg)</th>
<th>Normal SBP 120–129 or DBP 80–84</th>
<th>High normal SBP 130–139 or DBP 85–89</th>
<th>Grade 1 HT SBP 140–159 or DBP 90–99</th>
<th>Grade 2 HT SBP 160–179 or DBP 100–109</th>
<th>Grade 3 HT SBP ≥180 or DBP ≥110</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Other risk factors</strong></td>
<td><strong>OD or disease</strong></td>
<td><strong>No BP intervention</strong></td>
<td><strong>No BP intervention</strong></td>
<td><strong>Lifestyle changes for several months then drug treatment if BP uncontrolled</strong></td>
<td><strong>Lifestyle changes for several weeks then drug treatment if BP uncontrolled</strong></td>
</tr>
<tr>
<td><strong>No other risk factors</strong></td>
<td><strong>1–2 risk factors</strong></td>
<td><strong>Lifestyle changes</strong></td>
<td><strong>Lifestyle changes</strong></td>
<td><strong>Lifestyle changes for several weeks then drug treatment if BP uncontrolled</strong></td>
<td><strong>Lifestyle changes + Immediate drug treatment</strong></td>
</tr>
<tr>
<td><strong>3 risk factors, MS or OD</strong></td>
<td><strong>Diabetes</strong></td>
<td><strong>Lifestyle changes</strong></td>
<td><strong>Lifestyle changes and consider drug treatment</strong></td>
<td><strong>Lifestyle changes + Drug treatment</strong></td>
<td><strong>Lifestyle changes + Immediate drug treatment</strong></td>
</tr>
<tr>
<td><strong>Established CV or renal disease</strong></td>
<td></td>
<td><strong>Lifestyle changes + Immediate drug treatment</strong></td>
<td><strong>Lifestyle changes + Immediate drug treatment</strong></td>
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</tr>
</tbody>
</table>
• Lack of physical fitness is a strong predictor of cardiovascular mortality independent of blood pressure and other risk factors
• Aerobic exercise is any activity that uses large muscle groups, maintained continuously, rhythmic in nature.
• Dynamic resistance is when a body part moves against this force during contraction
• Isometric resistance is when a contraction is not followed by movement
EFFECTS OF EXERCISE ON BLOOD PRESSURE

Dynamic exercise

- BP increases in proportion to the intensity of the effort
- During longterm stable exercise, BP tends to decrease after an initial increase of short duration greater for systolic with slightly increased or unchanged diastolic
- For the same oxygen consumption, the rise is more pronounced in older subjects and when exercise is performed with smaller than with larger muscle groups
- Acute exercise is followed by post-exercise hypotension, which may last for several hours and is more pronounced and of longer duration in hypertensives than in normotensives

Static exercise

- BP increases during acute static exercise and the increase is more pronounced than with dynamic exercise, particularly with heavy static exercise at an intensity of >40-50% of maximal voluntary contraction
• Value and limitations of graded exercise testing in predicting future hypertension

• Role of acute and chronic endurance and resistance exercise on blood pressure

• Exercise prescription recommendations and special considerations for individuals with hypertension

• Potential physiologic mechanisms for the BP-lowering effects of acute and chronic exercise
• Value and limitations of graded exercise testing in predicting future hypertension

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Mechanisms of exaggerated BP response

• Total peripheral resistance does not fall adequately to compensate for the rise in cardiac output during exercise
• Increased peripheral vascular resistance and impaired capacity for exercise-induced vasodilatation
• Responses explained by:
  - hyper-reactivity of sympathetic nerves and an increased vascular response to adrenergic stimulation
  - thickening of the arteriolar wall that alters its ability to respond to vasonconstrictor stimuli
Prediction of future hypertension

- Exercise tests and the definition of an exaggerated BP response were not standardized across the various studies.

- Noninvasive BP measurements during exercise have inherent limitations, particularly with regard to diastolic.

- When exercise testing is performed for other reasons, BP measurement may provide useful prognostic information.
Prediction of CV complications

- The prognostic importance of exercise BP depends on the population studied, underlying clinical status and hemodynamic response.
- A worse prognosis is associated with a hypertensive response in healthy subjects.
- A worse prognosis is associated with an hypotensive response in patients with CV and heart failure (variability in hypertensive patients depending on cardiac output).
• Value and limitations of graded exercise testing in predicting future hypertension

• **Role of acute and chronic endurance and resistance exercise on blood pressure**

• Exercise prescription recommendations and special considerations for individuals with hypertension

• Potential physiologic mechanisms for the BP-lowering effects of acute and chronic exercise
Effect of endurance training on blood pressure, and regulating mechanisms
Cornelissen VA, Fagard RH Hypertension 2005, 46:667-675

• Exercise reduced resting systolic blood pressure by 3 mmHg and resting diastolic blood pressure by 2 mmHg
• In adult with hypertension reduces systolic pressure by about 7 mmHg and diastolic pressure by about 5 mmHg
• Aerobic training reduces vascular resistance through a 7.1% reduction in vascular resistance, a 29% reduction in plasma norepinephrine and 20% reduction in plasma renin activity
• Value and limitations of graded exercise testing in predicting future hypertension
• Role of acute and chronic endurance and resistance exercise on blood pressure
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• Potential physiologic mechanisms for the BP-lowering effects of acute and chronic exercise
Exercise prescription
Position stand - American College of Sports Medicine 2004

**Frequency:** on most, preferably all, days of the week

**Intensity:** moderate intensity (40-<60% of VO\(_2\)R)

**Time:** 30 min of continuous or accumulated physical activity per day

**Type:** primarily endurance physical activity supplemented by resistance exercise
Resistance or muscle-strengthening exercises
Physical Activity Guidelines Advisory Committee Report 2008 - US Department of Health and Human Services

- Progressive muscle strengthening exercises that target all major muscle groups performed on 2 or more days per week
- 8 to 12 repetitions of each exercise should be performed to volitional fatigue
- One set is effective; however, limited evidence suggests that 2 or 3 sets may be more effective
Walk, run or swim?

Jennings GL J.Hypert 1997, 15:567-569

• Moderate level of exercise lowered blood pressure, but this type of training reduced body weight, body fat and waist circumference

• Increased insulin sensitivity and HDL-cholesterol levels

• The type of exercise should be primarily endurance physical activity (walking, jogging, swimming) supplemented by resistance exercise
Exercise recommendations

• For person with high BP, an exercise program that is primarily aerobic-based is recommended
• Resistance training should serve as an adjunct to an aerobic-based program
• The evidence is limited regarding frequency, intensity, time and type recommendations
• Limited evidence exists regarding special considerations for those with hypertension
• Value and limitations of graded exercise testing in predicting future hypertension
• Role of acute and chronic endurance and resistance exercise on blood pressure
• Exercise prescription recommendations and special considerations for individuals with hypertension
• Potential physiologic mechanisms for the BP-lowering effects of acute and chronic exercise
Neurohumoral adaptation

• Elevated sympathetic nerve activity has been associated with increases in arterial wall thickening, training-induced decreases may be beneficial in preventing vascular remodeling
• Exercise training does not consistently reduce plasma renin and angiotensin II levels and RAAS does not appreciably contribute to the lowering of BP after training
• Vascular adaptations are likely to contribute to lower BP after training, exercise training alters the vascular responsiveness to two potent vasoconstrictors norepinephrine and endothelin-1
• Training-induced vascular remodeling may contribute to the anthypticrenives effect of exercise
• Genetic component to BP adaptations to exercise training