Exercise Physiology

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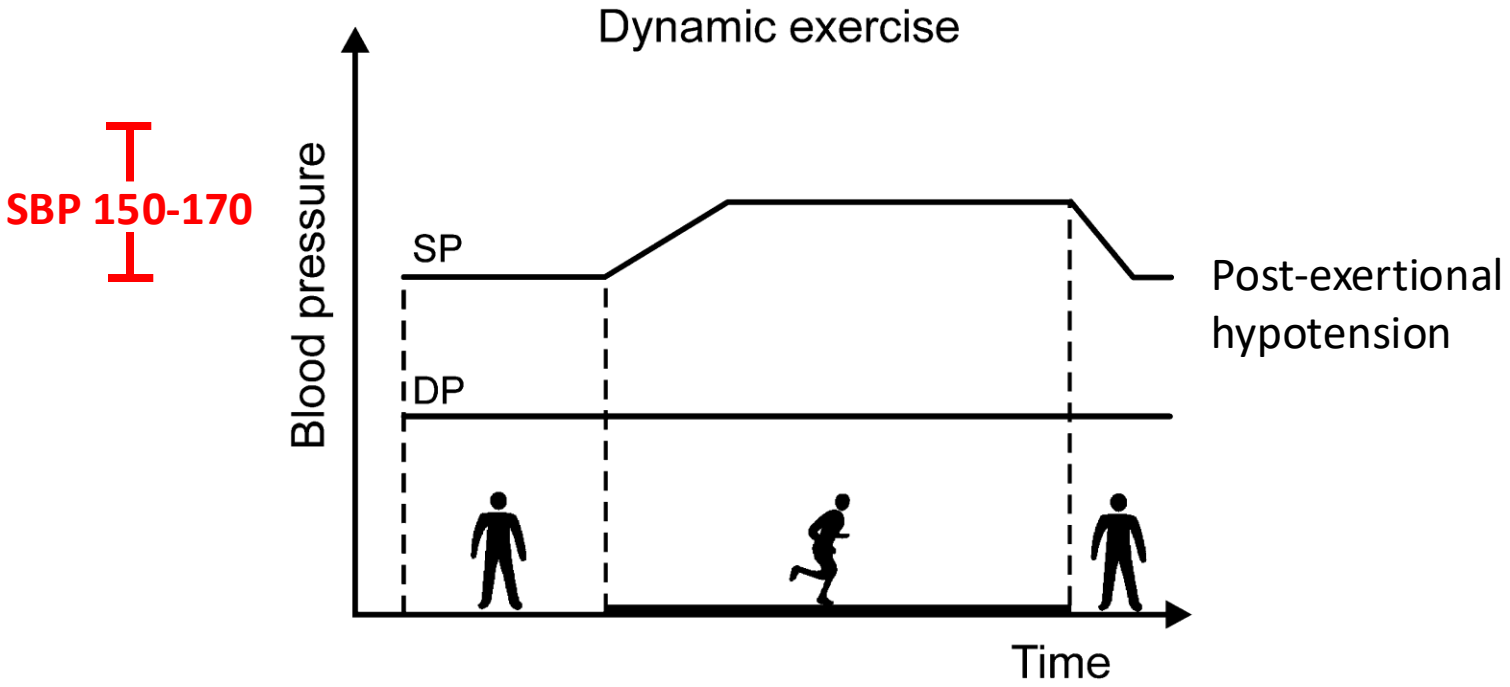
Outline

1. Physiology
2. Aortic Athletes Survey
3. Exercise Counseling

How safe is exercise for patients who have aneurysms or dissections?

- Regular exercise is safe for patients with large abdominal aortic aneurysms and may even decrease expansion rate
- Cardiac rehabilitation exercises after aortic repair appear to be safe (France, US, Swiss)
- In mice with Marfan syndrome gene mutations, regular exercise slows aortic disease progression
- Light to moderate-intensity exercises are safe in patients with thoracic aortic disease and may decrease aortic dilation

BP Response to Aerobic Exercise



- SBP increases gradually at first and plateaus
- SBP can be readily measured during aerobic exercise
- Provides opportunities to adjust intensity before threshold SBP is reached
- SBP increase may not be predictable from rest blood pressure

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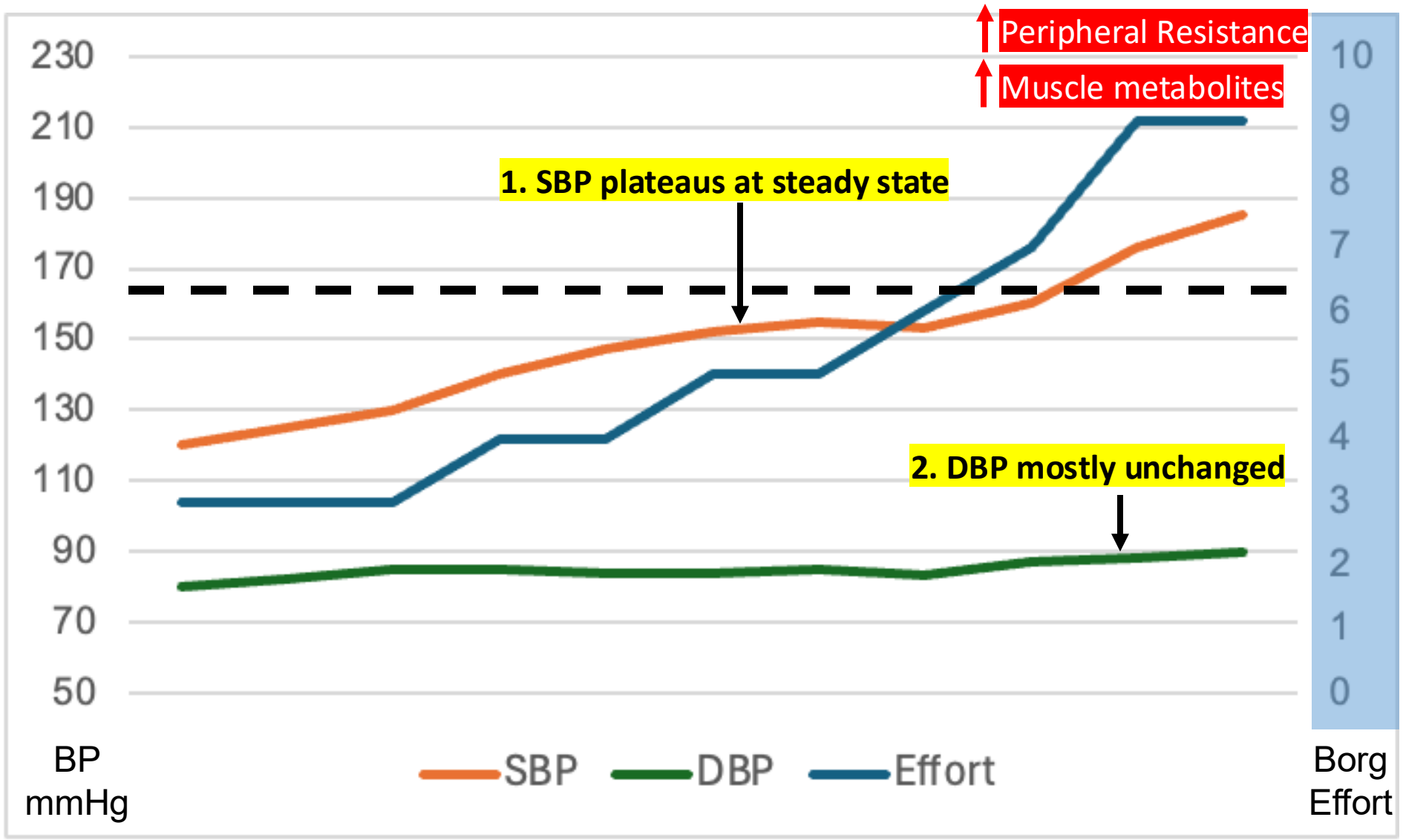
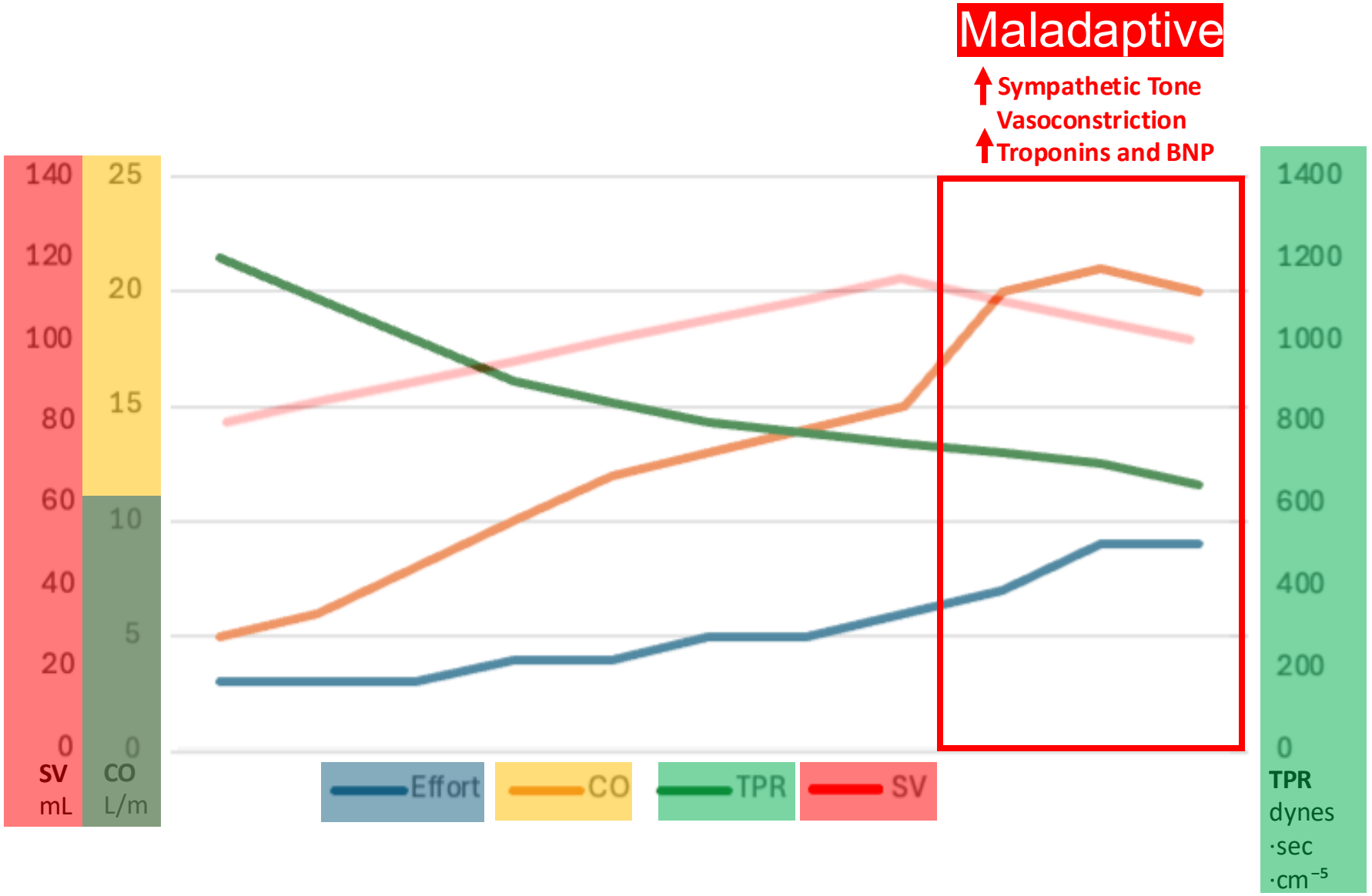
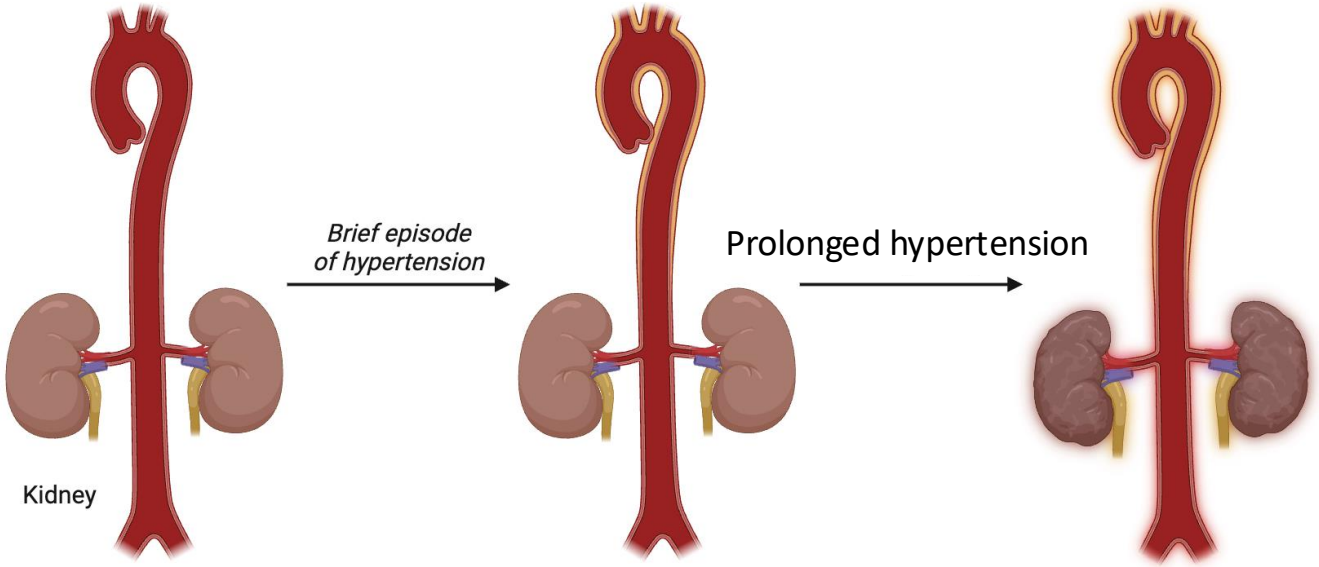
BP Response to Intense Aerobic Exercise

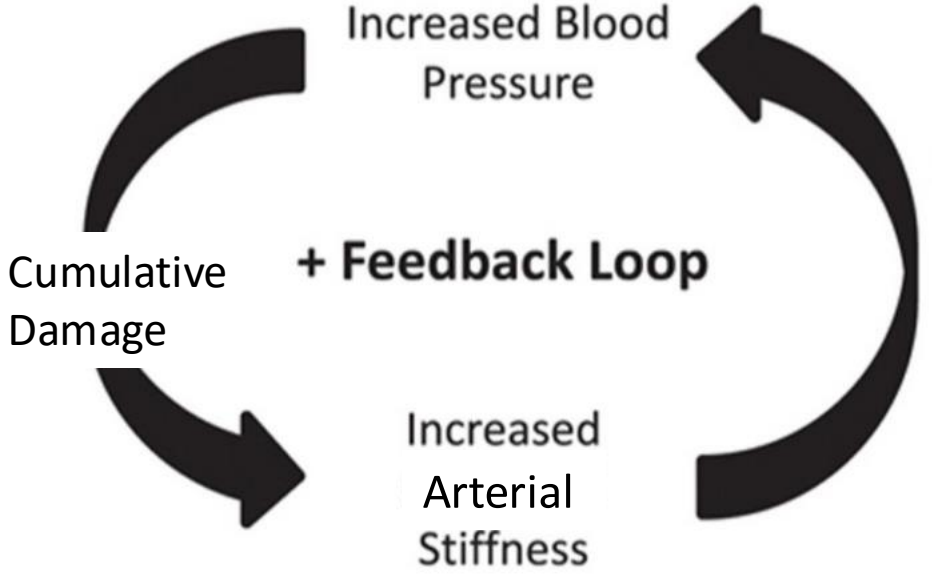


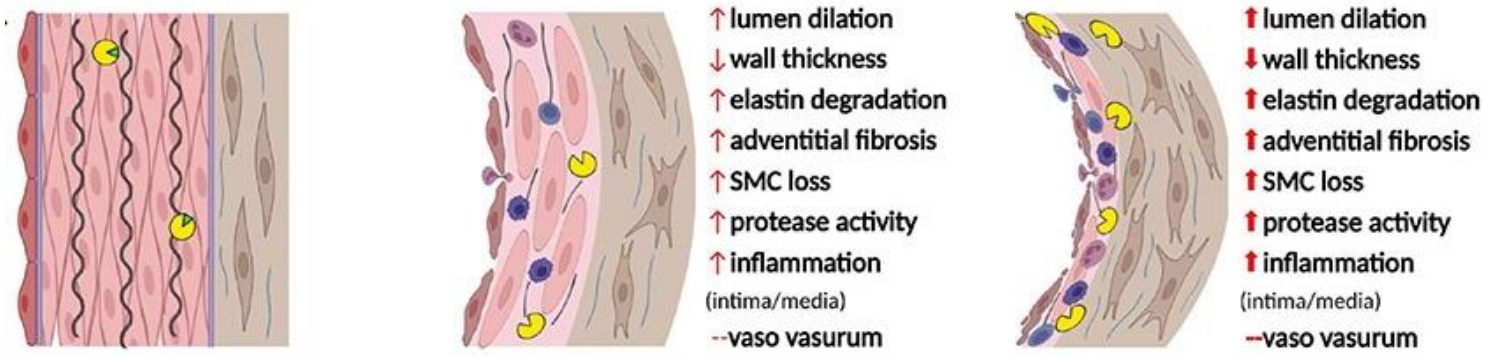
Physiology of Intense Aerobic Exercise



Hypertension, Intense Exercise, and Aortic Disease: Additive Effects on Aortic Pathology







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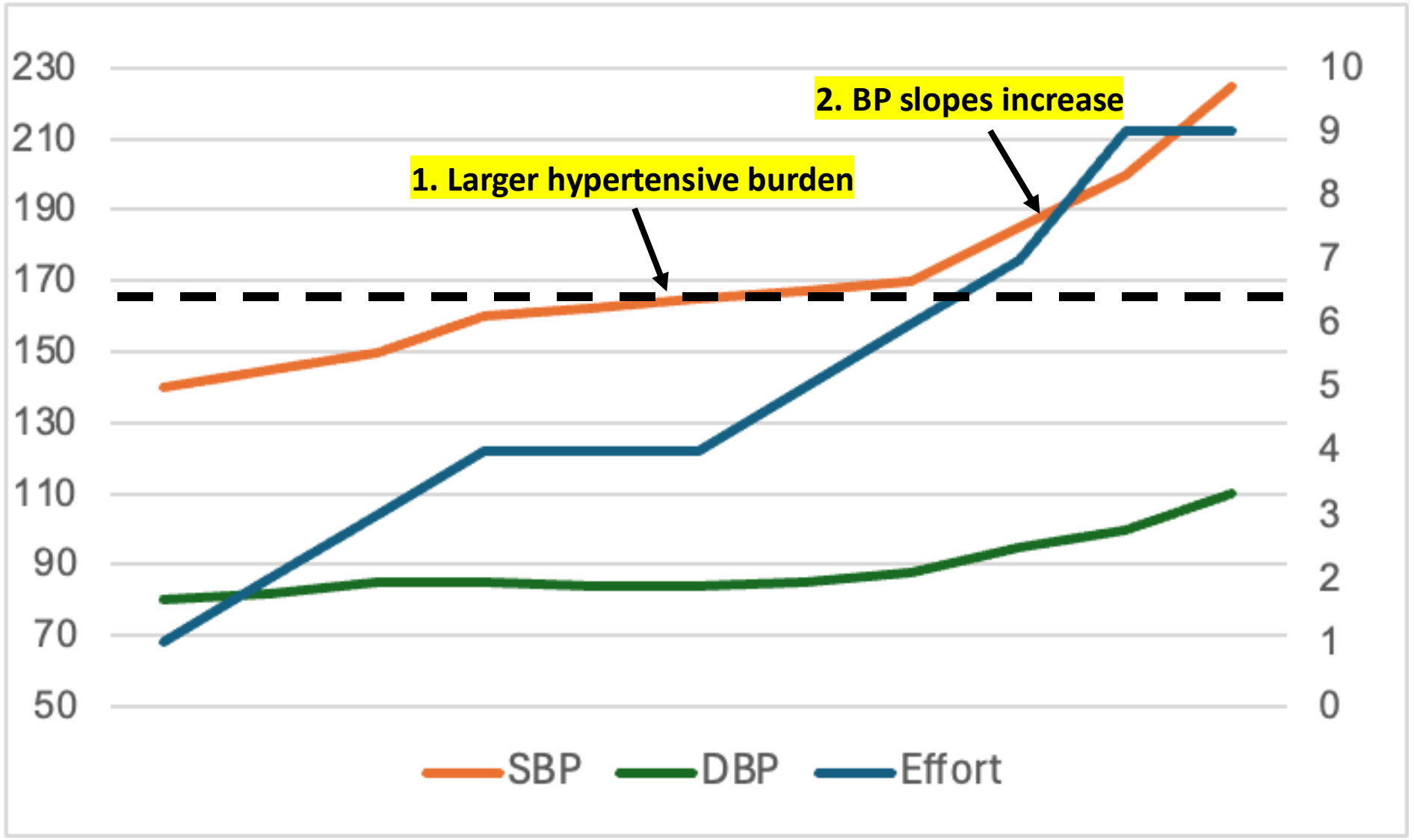
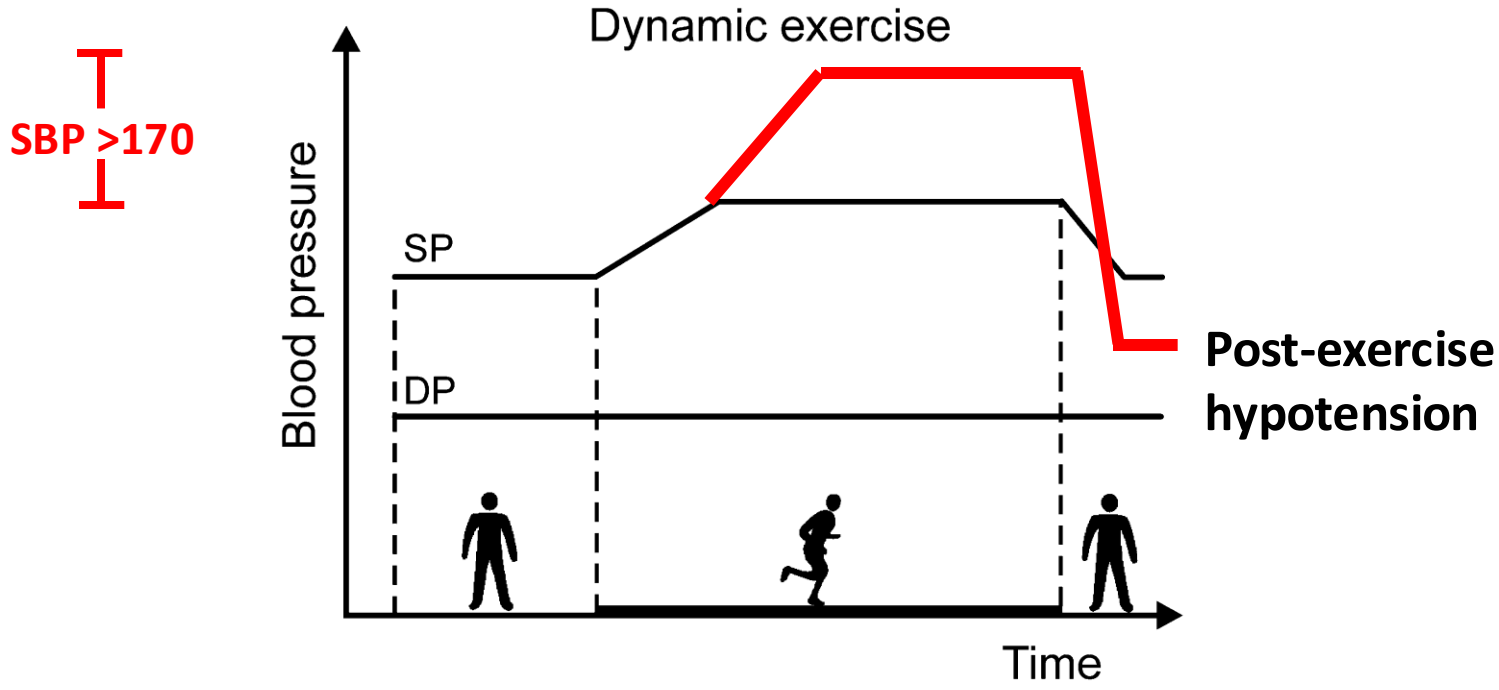
Aortic Stiffness

Effect of Chronic Hypertension on BP Response



Exaggerated BP Response to Aerobic Exercise



- Exercise BP is frequently ***not*** predictable from baseline BP
- SBP > 165 mmHg during moderate exercise predicts future hypertension, sudden cardiovascular death, and all-cause mortality (OR 1.33)
- Independent of BP, age, sex, and other established CVD risk factors
- Post-exertional hypotension is larger and more sustained when exercise intensity is higher

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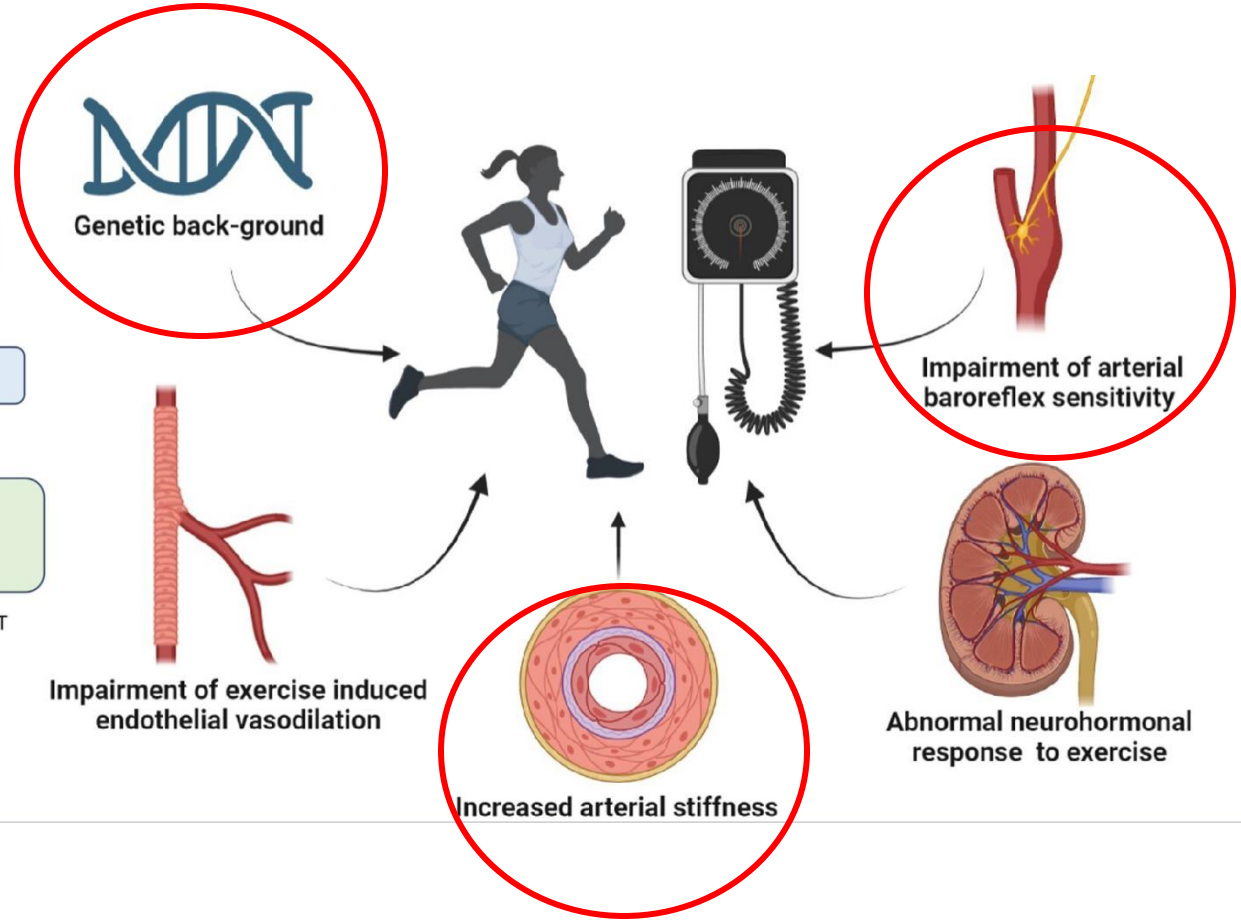
Exaggerated BP Response to Exercise: Risk Factors

SBP > 190-225 mmHg

AHA	MEN ≥ 210 mmHg *
	WOMEN ≥ 190 mmHg *
ESC	MEN ≥ 220 mmHg
	WOMEN ≥ 200 mmHg
ACSM	UNIVERSAL ≥ 225 mmHg

* AHA suggest a normative increase in SBP of 10 mmHg per MET



*Relevant to heritable aortopathies

Beta Blockers or ARBs: Discussion

Favors ARBs

- Slow **heart rate**
- ECG abnormalities
- Diabetes
- Erectile dysfunction
- Mood disorder
- Hypertension
- Aortic regurgitation
- Sports participation

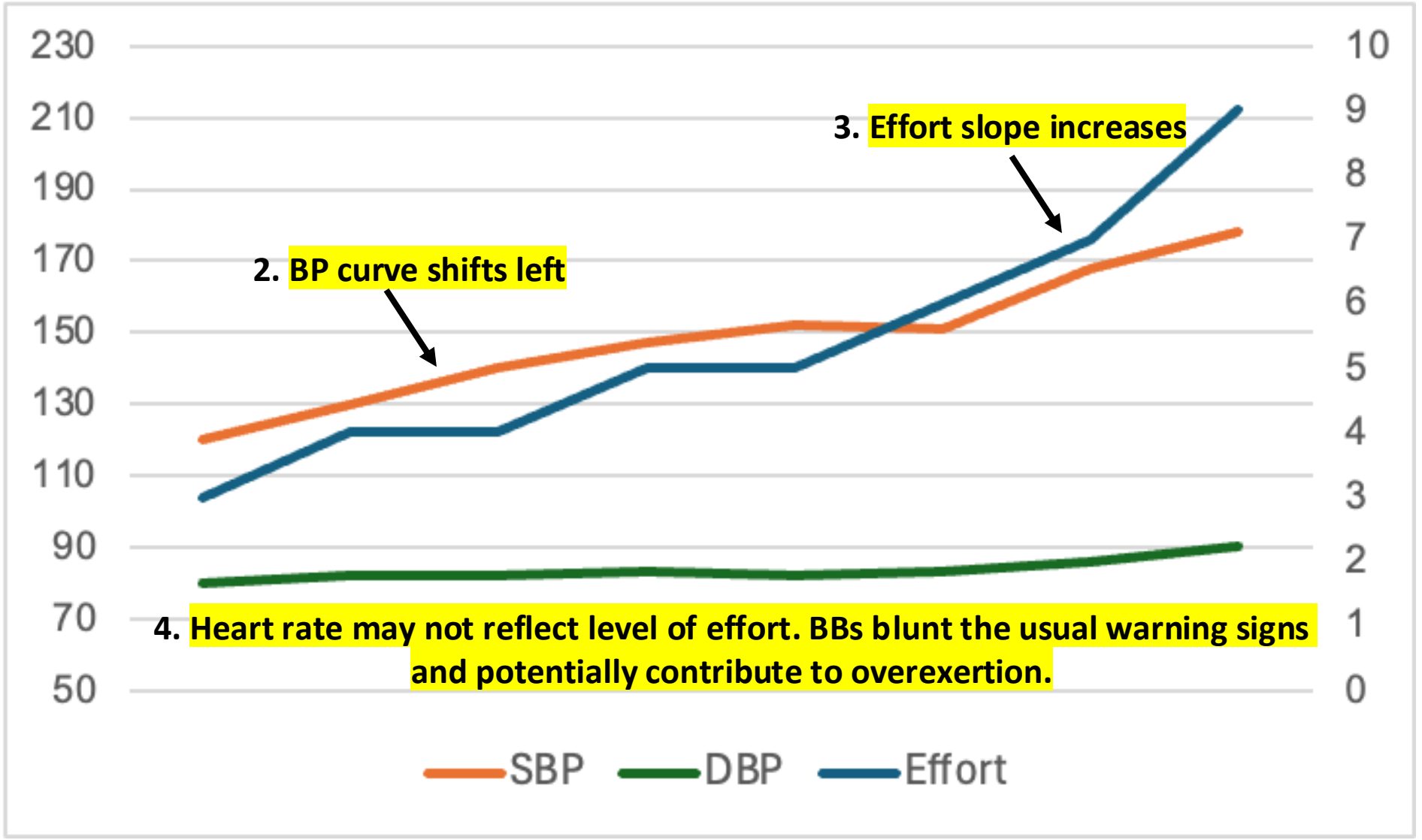
Favors BBs

- Rapid heart rate or fast arrhythmia
- Normal ECG
- Adverse reaction to ACE inhibitors
- Kidney disease
- Women who may become pregnant

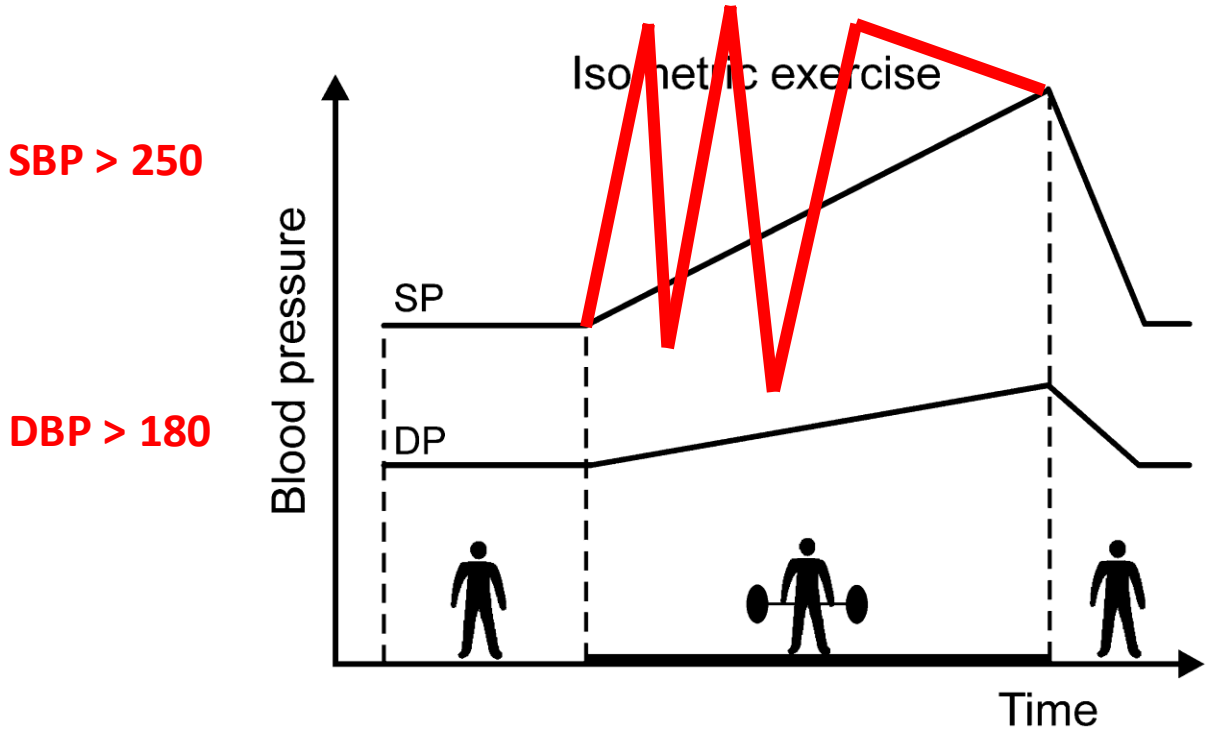
3-week trial of medication
Log home blood pressures before and after medications
Recommend basic metabolic panel if starting ARBs

Effects of Beta Blockers on Exercise

1. Decrease VO_2 max by 15%: lowers the threshold for maximal effort when BP can spike

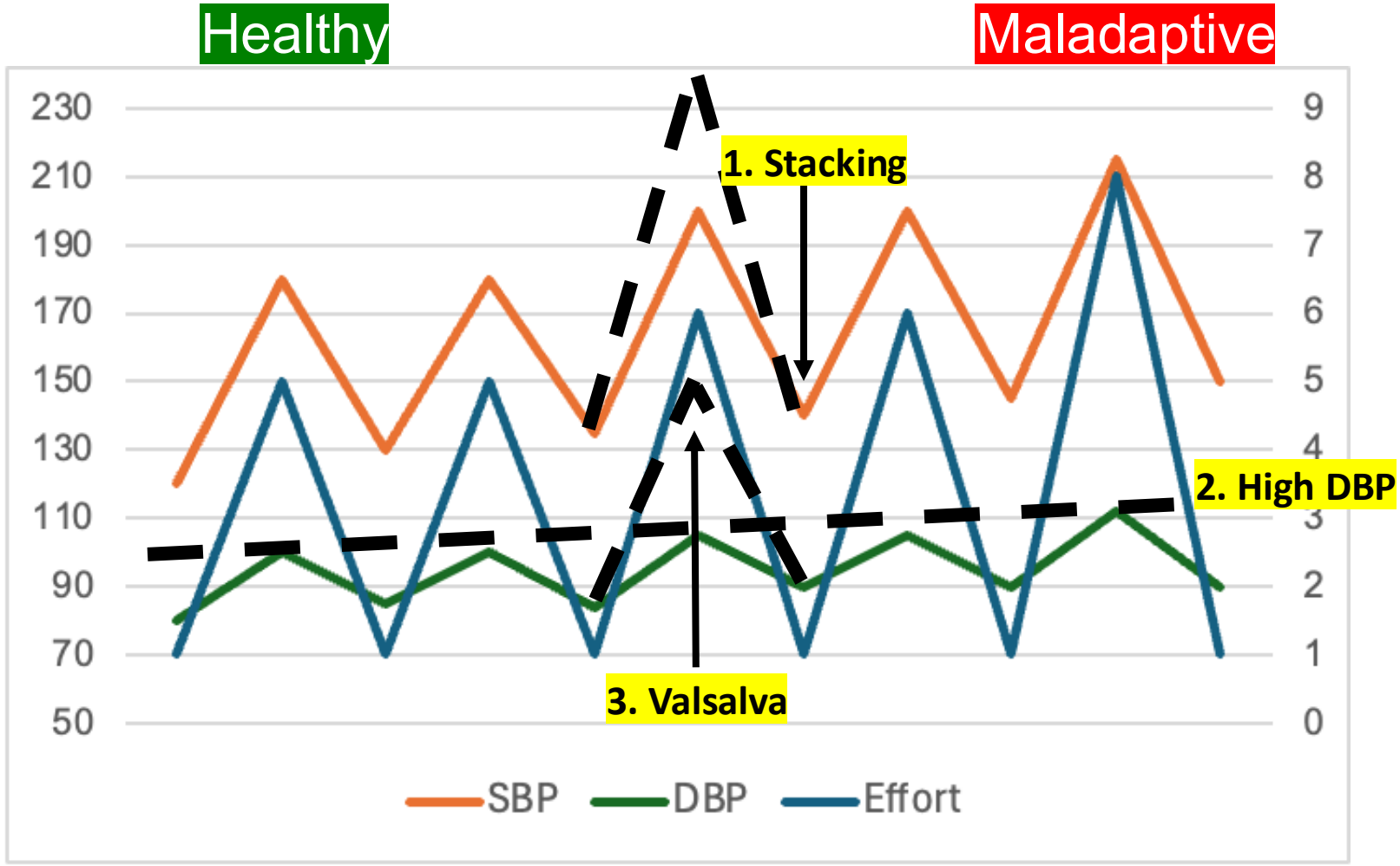


BP Response to Resistance Exercises



- BP increases in proportion to the % of body weight lifted or force applied
- Increases are sudden and short-lived
- SBP can not be readily measured during exercise
- Changes in BP vary from person to person depending on technique
- Limited opportunity to adjust the intensity of exercise before threshold SBP is reached

BP Response to Intense Resistance Exercises



Resistance Exercises: Conclusions

Magnitude of BP increase is hard to predict:

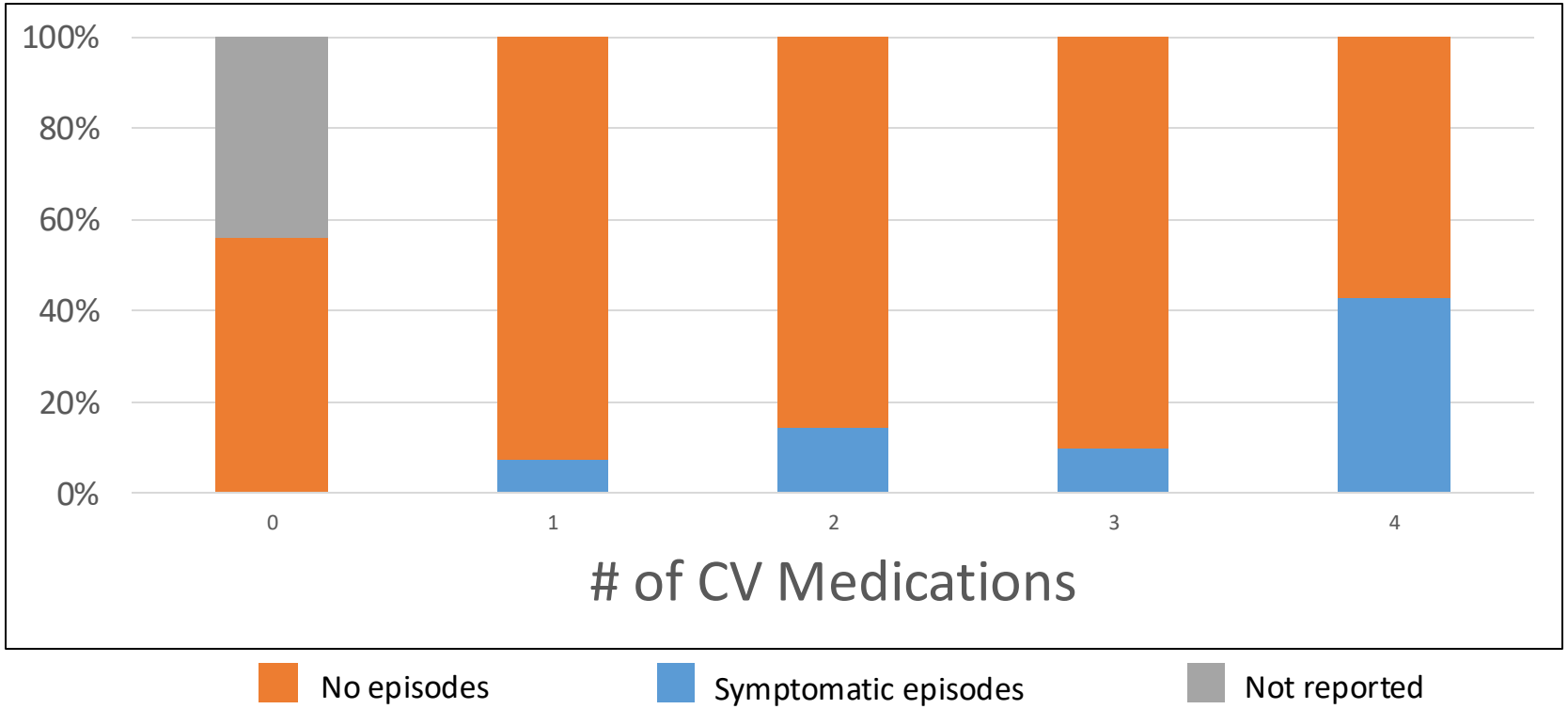
- Amount of weight lifted or force applied
- Breath holding (Valsalva maneuver)
- Number of repetitions
- Time between repetitions
- Strength or mass of recruited muscles
- Age and sex
- Medications relatively weak protective effects

Resistance training has beneficial effects:

- Bone density
- Frailty
- Decreases central aortic BP and total peripheral resistance

Aortic Athletes Survey

Post-Exercise Hypotension More Likely If on Multiple CV Medications



- 80% endurance aerobic activities
- 20% isometric or isotonic activities

Post-Exercise Hypotension More Likely If Less Training

Times in minutes	Symptomatic Hypotension Related to Competitive Event?	
	YES	**NO**
Weekly exercise time when NOT preparing for competitive event	150	362
Weekly training time for competitive events	198	378

Competitive Athletic Events After TAD Diagnosis: Conclusions

- Athletic activity after diagnosis of TAD is generally safe
- Up to 20% of endurance runners experienced pre-syncopal episodes
- Preventing event-related symptoms should include:
  - ❑ Improved conditioning
  - ❑ Hydration and ‘cool down’ period after exercise
  - ❑ Strategic changes to CV medications

Exercise Counseling

Before starting exercise

1. **What is dissection/rupture risk?**
   High blood pressure, smoking, type of gene mutation, family history, previous aortic surgery, pregnancy

2. **Is blood pressure well controlled?**
   Regular blood pressure checks and medication adjustments

3. **Is aorta changing?**
   Updated imaging

4. **What are they doing now and what do they want to do?**

Blood Pressure Control

Guidelines

12.1. Recommendations for Blood Pressure Control

Class I	**1.** Antihypertensive therapy should be administered to hypertensive patients with thoracic aortic diseases to achieve a goal of less than 140/90 mm Hg (patients without diabetes) or less than 130/80 mm Hg (patients with diabetes or chronic renal disease) to reduce the risk of stroke, myocardial infarction, heart failure, and cardiovascular death. *(LOE: B)*
	2. Beta adrenergic–blocking drugs should be administered to all patients with Marfan syndrome and aortic aneurysm to reduce the rate of aortic dilatation unless contraindicated. *(LOE: B)*

Practice

At rest:
120/80

During aerobic exercises:
165/90

During resistance exercises:
?

- Blood pressure during exercise is frequently different than resting BP

❑ Self-measured home blood pressure
❑ 24-hour ambulatory blood pressure monitoring
❑ Treadmill

Multidisciplinary Aortic and Vascular Disease Clinic

Guidelines for Living with Aneurysms and Dissections of the Aorta and Other Blood Vessels:

Practical exercise advice 1 (do's):

- Get checked out before you start to exercise, especially if you have been inactive for a while.
- We recommend light to moderate aerobic exercise each day, with a goal of 2 1/2 hours per week.
- We recommend light to moderate isotonic exercises (handgrips, wall sits) with a goal of 20 minutes on 2-3 days per week.
- Start low, go slow: low intensity, gradually ramp up.

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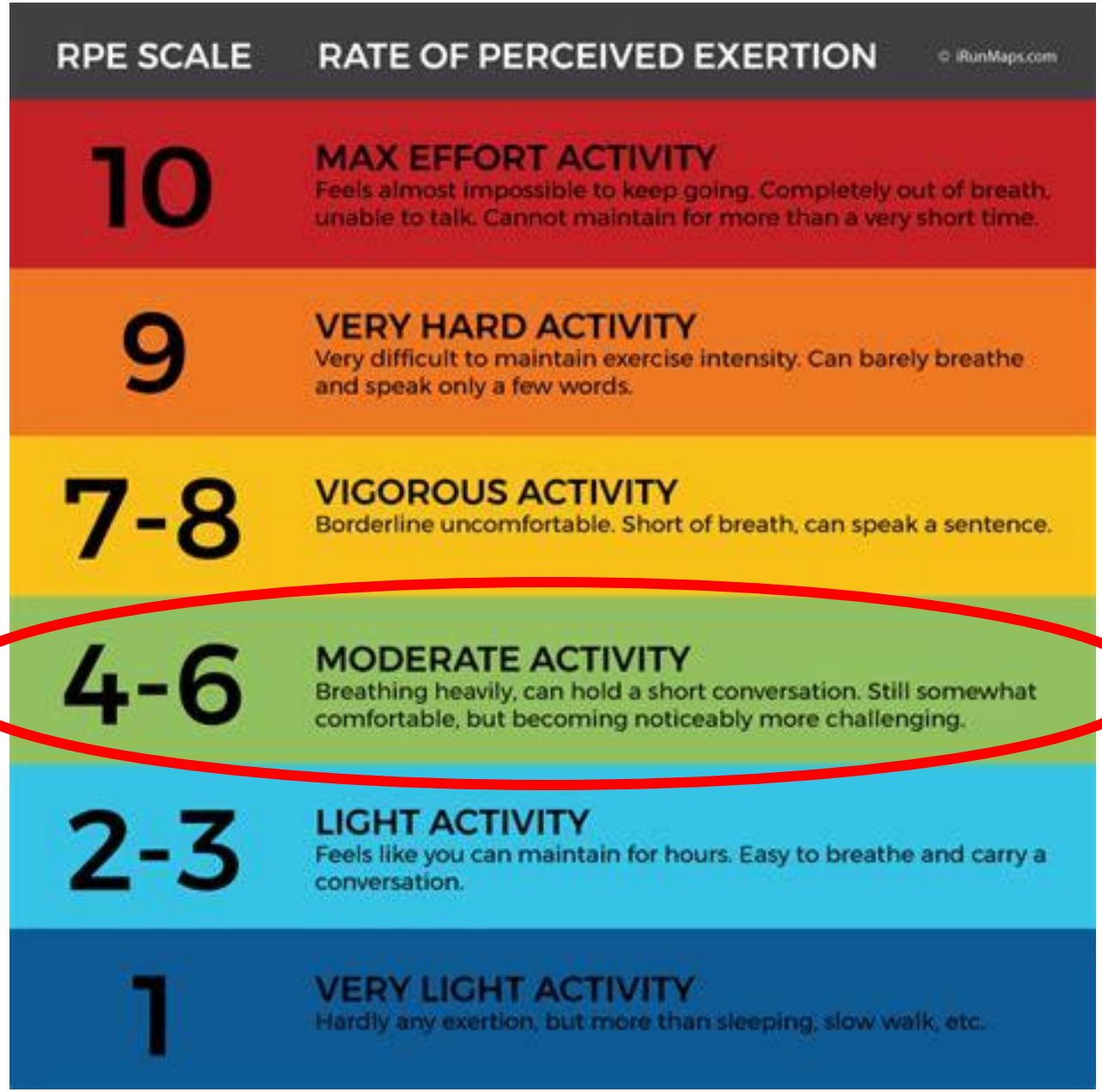
Guidelines for Living with Aneurysms and Dissections of the Aorta and Other Blood Vessels:

Practical exercise advice 2 (don'ts):

- You can lift whatever weight you can comfortably lift ***without having to "bear down."*** Avoid isometric exercises where you contract muscles without moving joints. These actions increase pressure on the aorta.
- Do not exert yourself to the point of exhaustion.
- Always ‘cool down.’ Don’t stop abruptly.
- If you take a beta blocker, heart rate zones may not be an accurate indicator of your exercise intensity. Instead, we recommend using a Rating of Perceived Exertion (RPE or Borg) scale.


RPE SCALE
RATE OF PERCEIVED EXERTION
© iRunMaps.com
10
MAX EFFORT ACTIVITY
Feels almost impossible to keep going. Completely out of breath, unable to talk. Cannot maintain for more than a very short time.
9
VERY HARD ACTIVITY
Very difficult to maintain exercise intensity. Can barely breathe and speak only a few words.
7-8
VIGOROUS ACTIVITY
Borderline uncomfortable. Short of breath, can speak a sentence.
4-6
MODERATE ACTIVITY
Breathing heavily, can hold a short conversation. Still somewhat comfortable, but becoming noticeably more challenging.
2-3
LIGHT ACTIVITY
Feels like you can maintain for hours. Easy to breathe and carry a conversation.
1
VERY LIGHT ACTIVITY
Hardly any exertion, but more than sleeping, slow walk, etc.

High-intensity exercise, hypertensive vascular disease, high dissection risk, or post-dissection

Diagnosis:

- Submaximal treadmill test and 24-hr ABPM
- Exaggerated blood pressure response?
- Post-exercise hypotension?

Management:

- Adjust antihypertensive therapies
- Light to moderate resistance training is OK
- Ramp up slowly
- Frequent re-evaluations

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