CASE STUDIES in Lifestyle Medicine

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Lifestyle Approaches to White Coat Hypertension

Abstract: *This case presentation illustrates the importance of 24 hour ambulatory blood pressure monitoring in patients with white coat hypertension, as many progress into sustained hypertension over time. Also, it serves as a reminder not to overlook a possible underlying sleep breathing disorder in patients who are not obese or fatigued. Finally, the case provides an opportunity to review the value of non-pharmacological and lifestyle approaches to the treatment of both white coat hypertension and sustained hypertension.*

Keywords: White coat hypertension; hypertension; 24 hour ambulatory blood pressure monitoring; upper airway resistance syndrome; sleep apnea

MD was a previously healthy 44-year-old year Caucasian man who presented to our integrative medical center for an executive physical examination, seeking a second opinion on recently diagnosed “white coat hypertension.” His blood pressures (BP) in his doctor’s office were reportedly as high as 165/85 mm Hg, but at home his BP had always been less than 120/80 mm Hg. He had recently relocated from Germany to the

United States as manager of an international start-up company. Several months before I met MD, his evaluation in Germany included a normal electrocardiogram and echocardiogram. His 24-hour BP monitoring was notable for a mean BP of 128/78 mm Hg, mean daytime BP of 134/83 mm Hg, and mean nighttime BP of 117/66 mm Hg (normal). At that point no additional action was advised other than periodic BP monitoring.

His past medical history was otherwise unremarkable. He was on no medications or supplements. His family history was positive for hypertension in his mother, but otherwise unremarkable. He described himself as happily married, a father of 3 children, and denied ever using tobacco products or recreational drugs. His self-reported stress level was high, primarily related to 10- to 11-hour work days and his worries about the economy. He averaged about 7 hours of sleep a night, but stated that his sleep quality was often negatively affected by his stress and worry.

Although he followed a vegetarian diet most of his adult life, he had recently added in fish about 3 times a week. He regularly ate vegetables, fruits, nuts, seeds, beans, and 2 Greek yogurts daily. He drank no coffee or

soda, and only drank an average of one glass of wine per month. His estimated sodium intake¹ was low, and potassium intake high (he never ate processed food, and most of his meals were home-made, plant based). He reported engaging in cardiovascular exercise 4 times a week (30-40 minutes of running on a treadmill—high intensity at heart rate above 150/min) along with weight training twice weekly with a personal trainer, and yoga once a week. He described himself as a spiritual person who prayed daily. He rated his energy level as excellent, albeit “nervous.”

On physical examination, he appeared healthy with a height of 5 foot 11 inches and weight of 155 pounds (body mass index 21.6 kg/m²), waist/hip ratio of 0.8, BP was 160/80 mm Hg in both arms and pulse was 88/min and regular. The remainder of his examination, including heart and lung sounds, was normal. Repeat BP measurement with a nurse was 140/80 mm Hg.

Additional diagnostic testing included the following:

1. Cardiometabolic stress testing showed no ischemic signs or symptoms with exercise, an excellent fitness level with a VO_2 max of 46 mL/min/kg and a maximum BP of 194/84 at peak

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exertion (norms per Cooper Institute, Dallas, TX).

2. Body composition by DEXA (dual energy X-ray absorptiometry) showed 12.5% body fat (very lean, norms per Cooper Institute, Dallas, TX).
3. Renal function, electrolytes, thyroid testing, urinalysis, and complete blood count were all within normal limits. Fasting blood glucose was 78 mg/dL and hemoglobin A1c was 5.4. Cardio C-reactive protein was 0.5 mg/L and 25-OH vitamin D was 28 ng/mL.

At this point, MD wanted to know what else he could do to address his white coat hypertension. Because he was already eating a healthy diet close to DASH (Dietary Approaches to Stop Hypertension)² dietary pattern, exercising³ regularly, and maintaining a healthy body weight, initial recommendations were as follows:

1. He was referred to a behavioral therapist to learn stress management tools,⁴ including meditation⁵ and biofeedback training using heart rate variability monitor.^{6,7} Following this, he started a meditation practice 20 minutes twice weekly, and used his heart rate variability program (emWave⁸—Institute of HeartMath, Boulder Creek, CA) daily.
2. Despite inconsistent evidence for benefit on hypertension, he started vitamin D supplementation⁹⁻¹¹ 1000 units daily, omega-3 fatty acids¹² 650 mg EPA (eicosapentaenoic acid) + 450 mg DHA (docosahexaenoic acid) daily, vitamin B6¹³ as pyridoxine 5-phosphate 30 mg daily, and a multiflavonoid supplement^{14,15}

On follow-up after 2 months, review of MD's home BP recordings averaged about 110/70 mm Hg. In his primary care physician's office, they continued to range from 149/78 to 158/80 mm Hg, but always decreased with repeated measurements. Carotid intima-media thickness (CIMT) scan of his carotid arteries was normal and his coronary calcium score was 0. Biweekly

acupuncture was added to his regimen.¹⁶⁻¹⁸

MD returned for follow-up 6 months later. In the interim, he was promoted to a higher position in his company, which brought on more stress and more disrupted sleep. Repeat 24-hour BP monitoring at this time showed an average BP of 146/87 mm Hg (maximum 172/103), with an average daytime BP of 152/89 mm Hg and a nighttime BP of 128/78 mm Hg. Since his average was now >130/80 mm Hg, he now met criteria for (sustained) hypertension (per 2013 European Society of Hypertension and Cardiology guidelines average blood pressure on ambulatory blood pressure monitor of 130/80 mm Hg or more, average daytime BP of 135/85 mm Hg or more, and average nighttime BP of 120/70 mm Hg or more are defined as hypertension). Lisinopril 5 mg daily was initiated. MD increased his exercise regimen to 1 hour daily on a treadmill at high intensity, for which he carved out time during his work day. He had his BP checked by a registered nurse 3 times per month with readings around 130/60, 140/80, 122/65, and 145/60 mm Hg. Low dose of lisinopril was continued.

A year later, 24-hour BP monitoring showed average BP of 125/75 mm Hg (maximum 152/92), with an average daytime BP of 132/80 mm Hg and average nighttime BP of 107/64 mm Hg (maximum 113/76).

Despite his feeling like he was handling his stress better, he continued to describe awakening several times a night. Neither he nor his wife reported snoring or abnormal breathing. A more focused examination at that time was notable for slightly narrow airways with only partial visualization of his uvula, Mallampati class III. At this point, we decided to look at MD's quality of sleep more carefully and MD underwent screening for sleep apnea using a "home" sleep study with Watch PAT (peripheral arterial tonometry) technology.^{19,20} This revealed no evidence of apnea with apnea/hypopnea index (AHI) of 1.3 and normal oxygen saturation of 96% to 99% throughout the study. However, it showed increased respiratory effort

related arousals (RERAs) with respiratory disturbance index (RDI) of 12.6 (normal less than 5), worsening to 20.6 during rapid eye movement (REM) sleep (but not confined to supine position). Sleep efficiency was poor: MD woke up 12 times during the study and was awake 20% of his time in bed. Treatment of his disturbed breathing was recommended with a mandibular advancement device given association of upper airway resistance with hypertension and well-known association of hypertension (including white coat hypertension) with sleep apnea.²¹⁻²³

MD moved back to Europe in 2015 but has continued to prioritize his health and stress reduction techniques. He arranged his office schedule to allow for an hour of exercise daily and two 10-minute biofeedback mini-breaks. He continues to work with an acupuncturist periodically, and meditates twice a week. He stopped using his mandibular device due to discomfort, but has done an online cognitive behavioral program (SHUTi) for sleep. He also uses a positional device (advised by another physician) to prevent him from rolling into supine position during sleep (although his respiratory events were not positional based on his sleep study) and has noticed significant improvement in his sleep quality. His BP at home consistently averages 105/60 mm Hg (never more than 120/70) and most recently even his BP at his primary care physician's office was completely normal. He feels in better health than ever before.

Discussion

Hypertension is one of the most common reasons for office visits and pharmaceutical prescriptions in primary care. It is associated with significant increased risk for stroke, heart failure, and coronary artery disease. White coat hypertension has been recognized as a risk factor for cardiac and carotid²⁴ atherosclerosis as well, and a significant percentage of patients progress to sustained hypertension.²⁵ Untreated white coat hypertension increased cardiovascular risk by adjusted hazard ratio of 1.42.²⁶ While many patients with

hypertension end up requiring more than one pharmaceutical for adequate control, nonpharmacological tools can be effective and are often underutilized.

Dietary salt restriction alone can result in lowering of BP by 4.8/2.5 mm Hg.^{27,28} DASH diet can lower BP by 6/4 mm Hg compared with a typical American diet containing the same amount of sodium and calories. Exercise can lower BP by 4-6/3 mm Hg, independent of weight loss. Office-measured BP was reduced by 16.1/9.9 mm Hg with DASH diet plus weight management.²

Studies on acupuncture are more heterogeneous. Acupuncture alone may only significantly lower diastolic BP (by 3 mm Hg); in combination with pharmaceuticals, acupuncture lowered BP by additional 8/4 mm Hg.¹⁸ Use of garlic has been shown to reduce blood pressure by 5.1/2.5 mm Hg in 970 participants, possibly more in subanalysis of those with hypertension.²⁹ Many other foods and spices and herbs have been shown to lower BP to various degrees, such as leafy greens and beets, nuts, olive oil, and hibiscus^{30,31} tea, and can be easily included in daily diet. Meditation may have the potential to lower BP by 4.7/3.2 mm Hg,³² although many studies on it were of low quality.

Sleep apnea, upper airway resistance syndrome, and other sleep disturbances may be unrecognized contributors to hypertension (especially resistant hypertension). Multiple arousals in upper airway resistance syndrome result in sympathetic overactivity, even in patients with no oxygen desaturations.²⁵ As this case illustrates, stress and disrupted sleep may contribute to elevated blood pressure, a “white coat” pattern of blood pressure response, and sustained hypertension even in patients with a normal body mass index, excellent body composition, a healthy diet, and excellent exercise routine. Disordered sleep breathing may be overlooked, especially in patients who do not complain of fatigue, or are not obese.

In the case described above, a very low dose of angiotensin-converting enzyme inhibitor in combination with several nonpharmacological approaches

hugely improved BP as well as overall quality of life. **AJLM**

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