

Association of Western Diet and Lifestyle with Circadian Hyperamplitude Tension and Mesor Hypertension Measured by Ambulatory Blood Pressure Monitoring

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Abstract: Effects of Western diet and lifestyle factors resulting in hypertension are known, however, the effects of lifestyle on blood pressure variability measured by ambulatory blood pressure monitoring are not sufficiently well known. In the present case, it has been observed that Western diet, sedentary behavior and mental load in a subject with normal blood pressures were associated with blood pressure disorders (VVD). Moderation in diet and lifestyle reversed the blood pressure variability, demonstrated by ambulatory blood pressure monitoring.

Keywords: Blood pressure, diet, exercise, pranayam breathing.

INTRODUCTION

We are pleased to have Dr Douglas Wilson in the Tsim Tsoum Institute because he himself is symbol of gentleness and generosity. Day and night are important for the life on earth which is governed by the 24 hour day and the continuous 24-hour cycle of light and darkness [1-5]. Wilson proposed to share the same views which Barter, Halberg, Germaine, Otsuka and Singh pointed out about the physiological functions; body temperature, blood pressures, heart rate, cortisol, catecholamines, blood glucose, energy intake and expenditure that also change, predictably throughout this 24 hour cycle [2-9]. This enables us to anticipate predictable environment fluctuations over the day and to optimise the timing of various biological mechanisms to this 24 hour cycle [1-5]. Disruption of this environmental cycle and/or the molecular mechanisms that interpret it, add a third dimension to this equation resulting in dysfunction or development of a disease collectively known as cardiovascular diseases (CVDs).

Nutrients that are present in our tissues may interact and help in the prevention of excessive variability in cardiovascular functions [10]. In this connection, development of an increasing trend in blood pressure or in blood pressure

variation and coronary artery function are quite important [2, 7, 9]. However, it also applies to other mind-body mechanisms involved in cardiovascular homeostasis, such as the autonomic nervous system, cardiac function, heart rate, endothelial function, haemostasis, as well as nutrient (salt, alcohol, antioxidants, vitamins, minerals, amino acids, lipid and carbohydrate) metabolism in the background of physical activity levels [5-9]. Halberg continues to educate what Barter said much earlier about circadian blood pressure variability [3-5]. Except to ascertain whether a patient is dead or alive, in all other cases the clinician may gain from assessing chronobiologically the variability of heart rate and blood pressures and other vital signs that undergo a broad spectrum of rhythmic and other changes [3].

It is interesting that rodents are monitored to develop drugs, but are not the species for whom the drugs are intended [3]. After about half a century, we begin to monitor blood sugar levels and to know the role of rapid glucose fluctuations in the development of complications and target organ damage in patients with diabetes mellitus. The role of primary risk factors; diet, physical activity, salt, stress and alcoholism, in patients with prehypertension or diabetes mellitus and its complications, particularly vascular diseases, needs further monitoring [10-13]. Monitoring blood pressure is equally timely, technically feasible for individual home- and website-based personalised care. Variations in blood pressures are related to time structure as well as to mind

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body connection [1-5]. Chronomedicine serves basic science and perhaps the management of societal illnesses; cardiovascular diseases (CVDs), diabetes mellitus, psychological disorders, degenerative brain diseases and cancer which are predisposed by primary risk factors and risk behaviours [2-9]. It is ignorance that hypertension experts around the world want to administer drugs to these subjects without knowing their exact blood pressures, which is open to bias. It clearly indicates that health is becoming a business for the industry supplying the drugs. We have forgotten the old dictum that find out the cause of the disease and treat it. It is well known that the cause of hypertension lies in the diet and lifestyle under influence of geomagnetic forces, so it is better to change it for treatment of prehypertension. Every health professional needs to know what are antihypertensive foods and lifestyle apart from the antihypertensive drugs [5-9]. Wilson and co-workers have also emphasized on analytical performance characteristics and chronobiological considerations in quality control [13]. Chronobiology is the science, in which we study biological functions according to time structure, and it establishes a strong relation of mind with brain, and its effects on body functions and dysfunctions such as vascular variability syndromes (VVSs) [1, 14-19].

Recent studies indicate that deficiency of omega-3 fatty acid in the diet appears to be important in the pathogenesis of brain-heart interactions leading to metabolic syndrome [10-12]. The effect of an alpha-linolenic acid-rich diet on the circadian rhythm of cardiac events has been found beneficially positive [10]. Omega-3 fatty acids can also modulate heart rate variability which is controlled by sympathetic and parasympathetic activity [1]. The Columbus Concept and The Tsim Tsoum concept places emphasis on such interactions of mind, brain and various organs of the body in relation to dietary n-3 fatty acids and other nutrients as well as other environmental factors [1, 20-25]. Further studies indicate that flavone containing foods; tea, cocoa, grapes, apple, beans can decrease blood pressures, endothelial dysfunction and insulin resistance due to their antioxidant, anti-inflammatory and nitric oxide activating effects [23]. It is possible that these nutrients may also decrease VVDs.

We detect blood pressure over-swinging and other vascular variability disorders (VVDs) such as an elevation of the MESOR (MESOR-hypertension) for midline estimating statistic of rhythm [4, 26-28]. Moreover, and this is a principal point, other VVDs can complicate a high blood pressure or may be induced by treating a high blood pressure. Most of the conventionally unrecognized VVDs change a risk of stroke or of a myocardial infarction from ~5% to near 100% over a 6 years period, and can sometimes be eliminated by changing the time of taking the medication, only [26-28]. A recent international consensus guided by leaders in cardiovascular physiology recognizes that 7-day/24-hour blood pressure and heart rate monitoring, when interpreted chronobiologically, can detect new risks associated with a very high likelihood of stroke [4]. It also recognizes that over one-third of 72 million Americans said to be treated for hypertension can have a great conventionally unrecognized risk increase that can often be removed by adjusting the timing of antihypertensive drugs. Chronobiologically, computer-implemented self-surveillance of blood pressure and heart rate by 7-day/24-h monitoring detects conditions to which

conventional treatment is now blind [4-9, 26-28]. In the present case, we describe that a Western diet and lifestyle can predispose VVDs which may be reversed by changing to a wild type diet and lifestyle.

CASE REPORT

An apparently healthy and asymptomatic male physician (RBS), aged 66 years, body weight 70.0 kg and waist circumference 96 cm presented for 7 day ambulatory blood pressure monitoring. In July third week (2009), his blood pressure by mercury manometer was 130/92 mmHg and pulse rate 82 per min after 5 minute of rest while sitting on a chair. His food consumption pattern was fruit, vegetable and nuts 410g/day, legumes and whole grains 350g/day, refined carbohydrates 250g/day, visible fat 35 g/day, milk 100g/day. His serum total cholesterol was 235mg/dl, LDL cholesterol 110mg/dl, HDL-C 50mg/dl, triglycerides 105mg/dl, blood glucose 89mg/dl and serum uric acid 5.4mg/dl. C-reactive proteins, TNF-alpha and IL-6 were within normal limits.

He was doing moderate exercise for about 20 min twice daily and pranayam breathing about 5 min twice daily. Alcohol intake was 4-10 drinks per week. Ambulatory blood pressure (BP) monitoring was carried out for 3-7 days, by adjusting the instruments to measure blood pressures every 30 min. Only ABPM instrument TM2421, supplied by A&D Company (Tokyo, Japan) was used in all the measurements. The oscillometric BP and heart rate data recorded were down loaded to a computer with the TM2021 or TM2023 interface, also from A&D Tokyo, Japan. Each record was analyzed by sphygmochron, a double barreled parametric and non-parametric method, comparing a person's, BP and heart rate characteristics, with those of healthy subjects, after adjustment of age and sex [4, 9]. A two component model consisting of cosine curves, with periods of 24 and 12 hours, approximating the circadian wave form was fitted by least squares to each data series. The MESOR (Midline Estimating Statistic of Rhythm), double 24-hour amplitude (a measure of the predictable variation within a day) and acrophase (a measure of the timing of overall high values recurring each day) was compared with 90% prediction limits derived from records of clinically healthy peers matched by gender and age. MESOR hypertension and or Circadian Hyper-Amplitude Tension (CHAT) were diagnosed, when the BP MESOR and or circadian amplitude of blood pressure were above the corresponding upper 95% prediction limit. Ecphasia was diagnosed, when the circadian acrophase is outside the 90% prediction limits of peers. All 3 conditions are associated with a large increase in cardiovascular risk, as are an increase in pulse pressure [4, 24-26].

In July 2009, MESOR systolic and diastolic blood pressures as well as ecphasia and pulse pressures were within normal limits. Another 7-day record made in the second week of Dec 2009, while returning from a visit to Poland and Moscow showed an increased MESOR systolic and diastolic blood pressures and CHAT. Blood pressure by mercury manometer was now 142 systolic and 92 mm Hg diastolic, pulse 80 per min and body weight 71kg and waste circumference 97cm. During this trip to Europe, there was an increase in alcohol intake 10-12 drink per week and during monitoring 6-8 drinks per week. Food consumption pattern

showed lower intake of fruit, vegetable and nuts 300g/day, legumes and whole grains 230g/day, higher intake of refined carbohydrates 450g/day and visible fat intake 30g/day, and milk 70g/day. In March 2010, another 6-day record was made which showed a decrease in MESOR systolic and diastolic blood pressures and absence of CHAT but blood pressures were on the higher side of normal range. These changes in blood pressures were associated with body weight 70.5kg, waste circumference 96 cm, blood pressure by mercury manometer 130/85 mm Hg, pulse rate 80 min. The subject then increased his physical activity to 30 min twice daily, pranayam breathing 10 min twice daily with increased consumption of fruits, vegetable and nuts (450g/day), whole grains and legumes (350g/day), lower intake of refined carbohydrates (150g/day). Visible fat intake(25-35g/day) and salt intake (5-6g/day) were similar during the last 6 months of the follow up.

DISCUSSION

This single case study clearly reveals that a Western type diet and decreased physical activity and mental load during travel and other mental activities during stay in the United States and Europe may have predisposed BP variability in this subject. However, changing the diet and life style by consuming more functional foods, doing slightly more exercise and pranayam breathing may have provided significant benefit resulting in normal blood pressures.

According to Halberg and co-workers, premetabolic syndrome may be defined by the presence of high normal blood pressure (systolic 121-129 and diastolic 81-89mm Hg), impaired glucose tolerance (fasting 101-110mg/dl) or hyperinsulinemia and any one or more of the vascular variability disorders; circadian hyperamplitude tension (CHAT), MESOR hypertension, ecphasia and endothelial dysfunction [4]. These disorders in conjunction with premetabolic syndrome may be grouped under vascular variability syndromes as proposed by Halberg [4]. In one study among Asiatic Indian immigrants to United States [15], 3-7 days ambulatory blood pressure monitoring revealed a high prevalence of VVDs compared to Caucasians.

Similarly, as compared with dipping, a classification based on chronobiological end points (such as the circadian amplitude and phase) interpreted in the light of reference values specified by gender and age offers superior discrimination in our data. Several abnormalities in the normal range can occur as (1) a (circadian) blood pressure overswinging or circadian hyperamplitude-tension (CHAT) gauged by a circadian amplitude exceeding the upper prediction limit of presumably clinically healthy peers of the same gender, age group, and ethnicity; (2) an excessive pulse pressure gauged by a persisting excessive difference between systolic pressure, when the heart contracts, and diastolic pressure, when the heart relaxes, measured around-the clock; (3) circadian ecphasia, an odd timing of the daily blood pressure swing in the absence of an oddly timed daily heart rate pattern to rule out effects of work and sleep schedule shifts that may affect the timing of both blood pressure and heart rate rhythms; or (4) too little heart rate jitter, gauged by a reduced around-the-clock standard deviation of heart rate.

In a 6-year cohort study by Otsuka *et al.* [16] among 297 patients with no initial history of morbid cardiovascular event undergoing 48-hour ambulatory blood pressure monitoring, a circadian amplitude above the upper 95% prediction limit of clinically healthy peers matched by gender and age had a relative risk of 4.27 (95% CI: 2.43, 7.51; $P < 0.001$), whereas nondipping was not discriminatory (RR 1.37; 95% CI: 0.75, 2.51; $P < 0.05$). Analyses of 1179 untreated patients by Cornelissen *et al.* [9, 17] indicated that the concomitantly assessed left ventricular mass index (LVMI) of patients with an abnormal circadian pattern of diastolic blood pressure (DBP) is greatly elevated (Fisher statistic from 1-way ANOVA: $F=15.959$, $P < 0.001$), contrasting with the LVMI of reverse dippers, nondippers, dippers, or extreme dippers ($F=1.605$, $P < 0.186$). Much larger LVMI values, considered as a surrogate outcome measure available from all 1179 patients, were observed in the presence of abnormal circadian patterns of DBP, whether the phase occurs at an odd time (ecphasia) or whether the amplitude is excessive (CHAT). Comparable elevations in LVMI are not seen for patients with an abnormal day-night ratio. A similar comparison based on systolic blood pressure also favours a classification based on cosinor-derived circadian characteristics, whether considering all patients (All) or only women (F) or men (M), as does broader evidence. In populations of presumably healthy subjects and untreated or treated hypertensive patients, usually with no prior cardiovascular morbidity, a classification in terms of dipping based on the day-night ratio, routinely assessed in our analyses, has not contributed risk information beyond prediction achieved by means of chronobiological end points.

Halberg and co-workers suggest that to detect variability disorders, we need to replace the single office measurement of blood pressure by a 7-day profile of 3-hourly (self-) or denser (e.g., half-hourly) automatic measurements analyzed chronobiologically, because there can be large day-to-day variability in circadian characteristics.(4) We may find a midline estimating statistic of rhythm (MESOR)-hypertensive patient, whose overall blood pressure is seemingly well treated by drugs, with acceptable measurements during office hours, but who may still have much too high or much too low values during the night: high DBP around 120 mm Hg values each night because the medication no longer works (patient DJ), or low DBP values 30 mm Hg because it works too well. In both cases, such nightly readings present a danger in themselves and because they are associated with the occurrence of CHAT that can also happen when most or all values are within the acceptable range [4, 19, 26]. In a recent study, Dubnov *et al.* described circadian rhythms of cardiac events among 1000 patients, in the second quarter of the day in the control group, which were significantly decreased by w-3 fatty acids and flavonoid-rich Indo-Mediterranean diet in the intervention group [10, 20-23]. Omega-3 fatty acid is also known to control mental load and behavior [24]. There is consistent evidence that fruit and vegetable rich diet can decrease blood pressures and modulate CVDs [28-32]. Singh *et al.* reported for the first time by ambulatory blood pressure monitoring, about half weekly pattern of blood pressure and heart rate in men and women of India as well as circadian decrease in antioxidant vitamins

and increased oxidative stress in the second quarter of 24 hours [33, 34]. An increased prevalence of circadian rhythms of CVDs events have been observed in the second quarter of 24 hours which could be modulated by nutrients [35, 36]. Chronomedicine should have been considered to be important in the pathogenesis and prevention of CVDs and other chronic diseases by the United Nations-High Level Meeting held in 2011 [37] because increased wealth has failed to cause significant improvement in health [38]. The chronomics study indicate that supplementation of omega-3 fatty acids, according to time structure may be protective against risk of CVDs which also supports the established view that a low omega-6/omega-3 fatty acid ratio diet may be protective against chronic diseases because this approach addresses the circadian system and it is the major issue in the Tsim Tsoom Institute for prevention of CVDs [39-41].

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CONFLICT OF INTEREST

Conflict of interest has not been declared by the authors.

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