

# Council's Corner: Hypertension Issues - a personal view



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**Why does such a large proportion of the world's population suffer from hypertension? There are several answers to this question, which may be addressed at the level of genetics, of physiology, and the interplay of these factors with the external environment.**

## **Role of the sympathetic nervous system and the renin-angiotensin-aldosterone system**

First of all, mammals are hard-wired to maintain the adequacy of the circulation. This is priority number one since without an adequate circulation life ends. Mechanisms have evolved, therefore, to defend the circulation at all costs. Defense of the circulation in the face of external perturbations includes maintenance of plasma volume, perfusion pressure, and cardiac output in situations involving hemorrhage, trauma, and volume depletion from vomiting and diarrhea, to name a few exigent circumstances. These mechanisms to defend the circulation are deeply embedded in our genome. The sympathetic nervous system (SNS) and the renin-angiotensin-aldosterone system (RAAS) are the major defenders of the circulation. These two systems are also the major factors in the pathogenesis of hypertension. The inherent activity of these two systems varies among different individuals; those individuals at the higher end of the activity distribution for these two traits would defend the circulation better under external challenge but would be liable to the development of hypertension under the right circumstances.

Since hypertension is associated with adverse effects on the cardiovascular system why have these traits persisted in populations? Because the adverse effects of hypertension are generally played out over the course of decades and manifest themselves in the post-reproductive years.

## **Regulation of blood pressure and the pressure natriuresis relationship**

Secondly, blood pressure is not a tightly controlled variable. Throughout the course of a 24-hour period BP varies widely depending on the activity of the subject. During exercise, for example, blood pressure increases markedly and during sleep, on the other hand, pressure falls significantly. Cardiac

output, plasma volume, and tissue perfusion, by way of comparison, are much more closely regulated. In a related fashion the relationship between blood pressure and sodium excretion demonstrates the primacy of extracellular fluid volume over pressure. All things being equal, as the BP rises sodium excretion increases. The kidneys, therefore, have an infinite capacity to correct for hypertension. This pressure natriuresis relationship explains the interplay between volume and pressure and is critical to understanding how hypertension develops and is sustained. As noted above an important component of the defense of the circulation is the maintenance of the circulating volume in the presence of hemorrhage or fluid loss. Both the SNS and the RAAS increase renal sodium reabsorption. This increased avidity for salt operates to preserve volume in the face of diminished extracellular fluid thereby helping to maintain an adequate circulation. In the sodium replete state, however, renal avidity for sodium shifts the pressure natriuresis relationship to the right; this rightward shift in the relationship means that to excrete the day's salt intake higher BPs are required, as pointed out by Arthur Guyton decades ago. The increased renal avidity for salt, therefore, creates a "natriuretic handicap" whereby the increase in BP is the compensatory mechanism recruited to maintain plasma volume in the face of enhanced renal sodium reabsorption.

## **The environment**

The two major environmental factors that interact with genetic background and the associated physiological traits are salt intake and caloric intake. Since the propensity for hypertension is associated with renal avidity for salt, it follows that this propensity will not be expressed on very low sodium diets, as has been amply demonstrated in populations that have habitually low salt intakes. On high sodium diets, in contrast, the conservative trait of enhanced sodium reabsorption necessitates an increase in blood pressure to maintain normal extracellular fluid balance. Increased caloric intake, with associated obesity, is also related to the development of hypertension, again through stimulation

of the SNS and RAAS by leptin and insulin.

## The moral of the story

Although we are not able to modify our conservative genetic endowment we can beneficially effect the expression of our inherited traits by altering the circumstances that bring them into play: consuming less salt and less calories.

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**In 2008, I participated in the bidding for the 2016 ISH biennial meeting on behalf of the CHL. Although our bidding for an ISH meeting in Beijing was not successful, we, the CHL, soon reached an agreement with the ISH to initiate an educational programme in the western part of China.**

For several decades, western China has been less focused on educational programmes for the management of hypertension, even though the disease burden of hypertension is no smaller, and possibly greater, than in the eastern part of China. West China is economically far behind east China. This explains why physicians from west China participate in national meetings much less than those from east China. It may also explain why pharmaceutical companies are less interested in the organization of promotional activities in west China. Pharmaceutical companies often invite experts from Europe and North America to give lectures in their educational and promotional meetings in China. However, those meetings are often organized in Beijing, Shanghai, Guangzhou and other major cities in east or south east China, but very rarely in cities in west China.

In 2009, at the invitation of the CHL, the ISH decided

to help organize teaching seminars on the management of hypertension in west China in collaboration with the Asian Pacific Society of Hypertension (APSH). Every year there were two seminars in two different cities of west China. Each seminar would be a whole day programme including several lectures on the latest advances in hypertension. Lecturers were jointly appointed and supported by the ISH, APSH and CHL.

In the past seven years, the teaching seminar has been to most of the capital cities of west and central China. All the ISH sitting presidents (Anthony Heagerty, Stephen Harrap, Ernesto Schiffrin and Rhian Touyz) and Secretary General of the APSH, Trefor Morgan, participated in the seminar. The CHL president, Zhaosu Wu, chaired these meetings over the years. Probably because of the impact of these international and national organizations, the seminars were well-attended, with hundreds of participants each. The total number of participants of the 14 seminars exceeded a few thousands.

In China, the prevalence of hypertension increased substantially from about 5% in the late 1950s to about 25% in 2012 (Figure). The control rate of hypertension remained less than 10% in the China National Blood Pressure Survey in 2012 and was even lower in west China.