Obesity

A Perspective from Hypertension

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KEYWORDS

• Obesity • Hypertension • Sodium • Sympathetic nervous system
• Renin-angiotensin-aldosterone system • Insulin resistance • Adipokines

KEY POINTS

- The prevalence of obesity-related hypertension is high worldwide and has become a major health issue.
- The mechanisms by which obesity relates to hypertensive disease are still under intense research scrutiny.
- The most recognized factors connecting obesity and hypertension are altered hemodynamics, impaired sodium homeostasis, renal dysfunction, autonomic nervous system imbalance, endocrine alterations, oxidative stress and inflammation, and vascular injury.
- Obesity-related hypertension should be recognized as a distinctive form of hypertension and specific considerations should apply in planning therapeutic approaches to treat obese individuals with high blood pressure.

INTRODUCTION

The prevalence of overweight and obesity in children and adults continues to increase worldwide and, because of their association with cardiovascular disorders, diabetes, and dyslipidemia, are becoming one of the major health issues. Obesity is often related to hypertension, either as a causative or a coexisting factor. Associations between body mass index (BMI) and arterial pressure are well established in different populations and across different age groups.[1–5] Several studies point to a direct association between overweight and obesity and hypertension in children[6,7] that increases the likelihood of hypertension burden in adult life.[8] Moreover, data from the Framingham Heart Study suggest that 78% of essential hypertension in men and 65% in

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women may be linked to weight gain,[2] whereas various interventions for weight loss in hypertensive obese subjects resulted in blood pressure reduction.[9–12] However, studies showing that not all obese individuals are hypertensive indicate a complex and multifactorial relationship between obesity and arterial blood pressure. Nevertheless, obesity has been identified as a strong risk factor for progression from prehypertension to more severe hypertensive disease[13–16] and maintenance of a BMI less than 25 kg/m^2 is considered crucial in primary prevention of hypertension.[9,10] Thus, this article discusses major known factors involved in the pathophysiology of obesity hypertension in an attempt to recognize a full spectrum of available treatment approaches because obesity seems to be a common underlying factor in treatment-resistant hypertension.

PATHOPHYSIOLOGY OF OBESITY-RELATED HYPERTENSION

Despite an increasing body of evidence indicating obesity as an important determinant of high blood pressure, the mechanisms by which obesity causes hypertension are still under intense research scrutiny. Among those recognized are altered hemodynamics, impaired sodium homeostasis, renal dysfunction, autonomic nervous system imbalance, endocrine alterations, oxidative stress and inflammation, and vascular injury.

Altered Hemodynamics

Obesity is a hemodynamically volume overload disease that results in increased cardiac output, which predicts development of increased arterial pressure and total peripheral resistance.[17–20] Increased cardiac output in obese people reflects the greater metabolic requirements that accompany increased adipose tissue. It is augmented by redistributing the circulating blood volume to the cardiopulmonary area, thereby resulting in an increased venous return.[17,19,21–23] In addition, increased vascular resistance caused by increased blood viscosity[24] or other changed rheological properties of red blood cells[25] could also contribute to increased blood pressure in obese hypertensive people. The left ventricle adapts to obesity-related blood volume expansion by developing eccentric hypertrophy regardless of the level of arterial pressure.[26] In the presence of hypertension, the expanded intravascular volume is superimposed on the increased peripheral resistance and resulting pressure overload.[21,22] As described by Frohlich,[22] obesity-related hypertension is a state of hyperdynamic circulation responsible for a dual overload of the left ventricle. The cardiac challenge in obesity-related hypertension is greater than the risk associated with either disease alone, carrying higher risk for cardiovascular morbidity and mortality in obese hypertensive patients. If hyperlipidemia, diabetes mellitus, or accelerated atherosclerosis are also present, as they frequently are, these individuals have an even greater risk of coronary arterial insufficiency, myocardial infarction, cardiac dysrhythmia, and sudden death.[27–29]

Impaired Sodium Homeostasis

In several epidemiologic, clinical, and experimental studies, sodium intake was positively related to blood pressure.[30,31] The association was seen in children and adolescents, and it was even stronger among those who were overweight or obese.[32] Increasing sodium intake has been identified as a potential risk factor for obesity in children and adults independent of energy intake.[33] Frohlich and colleagues[19] reported higher sodium excretion in obese patients, which could be explained by their increased food and salt intake. Increases in blood pressure caused by high salt intake have been linked to inherent inability of the kidneys to excrete their increased sodium load. However, the preponderance of clinical and experimental evidence shows that

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