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STATE-OF-THE-ART PAPER

The Transition From Hypertension to Heart Failure

Contemporary Update

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ABSTRACT

Longstanding hypertension ultimately leads to heart failure (HF), and as a consequence most patients with HF have a history of hypertension. Conversely, absence of hypertension in middle age is associated with lower risks for incident HF across the remaining life course. Cardiac remodeling to a predominant pressure overload consists of diastolic dysfunction and concentric left ventricular (LV) hypertrophy. When pressure overload is sustained, diastolic dysfunction progresses, filling of the concentric remodeled LV decreases, and HF with preserved ejection fraction ensues. Diastolic dysfunction and HF with preserved ejection fraction are the most common cardiac complications of hypertension. The end stage of hypertensive heart disease results from pressure and volume overload and consists of dilated cardiomyopathy with both diastolic dysfunction and reduced ejection fraction. "Decapitated hypertension" is a term used to describe the decrease in blood pressure resulting from reduced pump function in HF. Progressive renal failure, another complication of longstanding hypertension, gives rise to the cardiorenal syndrome (HF and renal failure). The so-called Pickering syndrome, a clinical entity consisting of flash pulmonary edema and bilateral atheromatous renovascular disease, is a special form of the cardiorenal syndrome. Revascularization of renal arteries is the treatment of choice. Most antihypertensive drug classes when used as initial therapy decelerate the transition from hypertension to HF, although not all of them are equally efficacious. Low-dose, once daily hydrochlorothiazide should be avoided, but long-acting thiazide-like diuretics chlorthalidone and indapamide seem to have an edge over other antihypertensive drugs in preventing HF. (J Am Coll Cardiol HF 2017;■:■–■) © 2017 by the American College of Cardiology Foundation.

Most longstanding hypertension ultimately leads to heart failure (HF) unless this sequence of events is otherwise interrupted by other outcome and as a consequence, patients with HF very commonly have a history of hypertension. In the Framingham Heart Study cohort in a total population of 5,143 subjects, hypertension antedated the development of HF in 91% of all newly diagnosed HF patients during up to 20 years of follow-up (mean 14.1 years) (1). Adjusting for age and HF risk factors, the hazard for developing HF in hypertensive compared with normotensive subjects in the Framingham Heart Study data was about 2-fold in men and 3-fold in women. Multivariable analyses revealed that hypertension had a high population-attributable risk for HF, accounting for 39% of cases in men and 59% in women. Among hypertensive subjects, myocardial infarction, diabetes, left ventricular (LV) hypertrophy, and valvular heart disease predicted an increased risk for HF in both sexes. At 80 years of age, the lifetime risk of HF was about 20% in the Framingham cohort, and this risk doubled for patients with blood pressure (BP) of 160/100 mm Hg compared with those with 140/90 mm Hg (2).

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ABBREVIATIONS AND ACRONYMS

ARAS = atheromatous renal artery stenosis

ACE = angiotensin-converting enzyme

ARB = angiotensin receptor blocker

BP = blood pressure

CCB = calcium-channel blocker

CI = confidence interval

CRS = cardiorenal syndrome

CRT = cardiac resynchronization therapy

HF = heart failure

HFpEF = heart failure with preserved ejection fraction

HFrEF = heart failure with reduced ejection fraction

LV = left ventricular

RR = risk ratio

SBP = systolic blood pressure

Not surprisingly, prevention of hypertension and other HF risk factors such as obesity and diabetes during middle age substantially prolongs HF-free survival. Men and women without hypertension, obesity, or diabetes at 45 years of age lived on average 34.7 years and 38.0 years without incident HF, and they lived on average an additional 3 to 15 years longer free of HF than did those with 1, 2, or 3 risk factors (3). Thus, the absence of hypertension, obesity, and diabetes by 45 and 55 years of age is associated with up to 86% lower risks for incident HF in men and women across the remaining life course. Importantly, the 22-year follow up of the SHEP (Systolic Hypertension in the Elderly Program) trial documented that compared with placebo, each month of active chlorthalidone-based antihypertensive therapy during the trial period of 4.5 years was associated with 1-day prolongation of life expectancy free from cardiovascular death (4).

PATHOPHYSIOLOGY

In most hypertensive patients LV diastolic dysfunction is the first discernible manifestation of heart disease (**Figure 1**). Cardiac remodeling to a predominant pressure overload consists of concentric LV hypertrophy (increase in cardiac mass at the expense of chamber volume). In contrast, cardiac remodeling to a predominant volume overload (e.g., obesity, chronic kidney disease, anemia) consists of eccentric hypertrophy (increase in cardiac mass and chamber volume) (5). When pressure overload is sustained, diastolic dysfunction progresses, the concentric remodeled LV decompensates, and hypertensive HF with preserved ejection fraction (HFpEF) ensues. In contrast, when volume overload is sustained, LV dilatation progresses, the eccentric remodeled LV decompensates, and HF with reduced ejection fraction (HFrEF) ensues. The combination of LV hypertrophy with increased levels of biomarkers of subclinical myocardial injury (high-sensitivity cardiac troponin T, N-terminal pro-B-type natriuretic peptide) identifies patients at highest risk for developing symptomatic HF, especially HFrEF (6). The end stage of hypertensive heart disease, usually the result of longstanding pressure and volume overload, consists of dilated cardiomyopathy with both diastolic dysfunction and reduced ejection fraction.

From a clinical point of view hypertensive heart disease can be divided into 4 ascending categories, based on the pathophysiologic and clinical impact of hypertension on the heart:

Degree I: Isolated LV diastolic dysfunction with no LV hypertrophy

Degree II: LV diastolic dysfunction with concentric LV hypertrophy

Degree III: Clinical HF (dyspnea and pulmonary edema with preserved ejection fraction)

Degree IV: Dilated cardiomyopathy with HF and reduced ejection fraction (7)

The categories would indicate that diastolic dysfunction is a much more common complication of longstanding hypertension than is systolic dysfunction. Patients with HFpEF have more LV hypertrophy, epicardial coronary artery lesions, coronary microvascular rarefaction, and myocardial fibrosis than do control subjects. Coronary microvascular dysfunction may conceivably be the result of a systemic inflammatory state and oxidative stress accelerated by comorbidities of HFpEF (8,9). Importantly, isolated diastolic dysfunction also can trigger pulmonary edema, as was documented by Gandhi et al. (10). They found LV ejection fraction during an episode of acute hypertensive pulmonary edema to be similar to the one measured after treatment, when the BP had been controlled. In these patients systolic BP (SBP) was 200 ± 26 mm Hg during the initial echocardiographic examination and reduced to 139 ± 17 mm Hg at the time of the follow-up examination. Thus, a normal LV ejection fraction after the treatment of a patient with hypertensive pulmonary edema allows us to conclude that the pulmonary congestion was due to isolated, transient diastolic dysfunction. Transient systolic dysfunction with or without mitral regurgitation seemed to be infrequent during acute episodes in these patients (10).

DECAPITATED HYPERTENSION

In advanced HF SBP is usually low, even in patients who were previously hypertensive. This phenomenon is termed “decapitated hypertension”: patients who are hypertensive to begin with progressively develop normal and even low BP as HF becomes more severe. Severe LV dysfunction can be a powerful antihypertensive mechanism. The decrease in SBP results from reduced pump function and fall in cardiac output despite the presence of compensatory mechanisms such as peripheral vasoconstriction. Patients with decapitated hypertension are difficult to manage because of their inability to tolerate HF medications, most of which tend to lower BP, such as