

## Hypertensive Heart Disease

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### Continuing Education Activity

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Hypertensive heart disease refers to a constellation of changes in the left ventricle, left atrium, and coronary arteries as a result of chronic blood pressure elevation, which increases the workload on the heart inducing structural and functional changes. These changes include hypertrophy of the left ventricle, which can progress to heart failure; patients with left ventricular hypertrophy have significantly increased morbidity and mortality. Hypertensive heart disease ultimately encompasses all of the direct and indirect sequelae of chronic high blood pressure which include systolic or diastolic heart failure, conduction arrhythmias, especially atrial fibrillation, and increased risk of coronary artery disease. This activity reviews the evaluation of hypertensive heart disease and identifies the role of the interprofessional team in managing this condition.

#### Objectives:

- Describe the typical presentation of hypertensive heart disease.
- Review the evaluation of hypertensive heart disease.
- Summarize the treatment approach to hypertensive heart disease.
- Explain the role of collaboration among interprofessional team members to improve care coordination and minimize oversight, leading to earlier diagnosis and treatment and better outcomes for patients with hypertensive heart disease.

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### Introduction

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Hypertensive heart disease refers to a constellation of changes in the left ventricle, left atrium, and coronary arteries as a result of chronic blood pressure elevation. Hypertension increases the workload on the heart inducing structural and functional changes in the myocardium. These changes include hypertrophy of the left ventricle, which can progress to heart failure. Patients with left ventricular hypertrophy have significantly increased morbidity and mortality, but current treatment follows standard hypertension guidelines as the effects of pharmacotherapy on regression of left ventricular hypertrophy has unclear benefits.

Hypertensive heart disease is subclassified by the presence or absence of heart failure as the management of heart failure requires more intensive goal-directed therapy. Hypertensive heart disease can lead to either diastolic heart failure, systolic failure, or a combination of the two. Such patients are at a higher risk for developing acute complications such as decompensated heart failure, acute coronary syndrome, or sudden cardiac death. Hypertension disrupts the endothelial system which increases the risk of coronary artery disease and peripheral arterial disease and thus represents a significant risk factor for the development of atherosclerotic disease. However hypertensive heart disease ultimately encompasses all of the direct and indirect sequelae of chronic high blood pressure which include systolic or diastolic heart failure, conduction arrhythmia especially atrial fibrillation, and increased risk of coronary artery disease.

### Etiology

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Hypertensive heart disease results from chronic high blood pressure. Current 2017 American Cardiology Association/American Heart Association guidelines define hypertension as blood pressure as systolic blood pressure higher than 120 mm Hg or a diastolic pressure more than 80mm Hg. The risk of cardiovascular mortality doubles for every 20mmHg systolic and 10mmHg diastolic pressure increase over a baseline blood pressure of 115/75.[1]

The vast majority (90 to 95%) of hypertensive patients will classify as having primary or essential hypertension. The etiology behind primary hypertension is poorly understood. However, it likely is a complex interplay between genetic and environmental factors. Several risk factors such as increasing age, family history, obesity, high sodium diets (greater than 3g/day), physical inactivity, excessive alcohol consumption have strong and independent correlations with the development of hypertension. Hypertension has been found to precede the development of heart failure by an average of 14.1 years.[2]

Hypertensive heart disease is responsible for roughly one-fourth of all causes of heart failure. According to the Framingham Heart Study, hypertension has a 2-fold increase in the development of heart failure in men and a 3-fold increase for women when adjusted for specific risk factors and age. The 2015 SPRINT trial demonstrated a reduced risk of progression to heart failure in patients with more intensive blood pressure control with a target systolic blood pressure of 120mmHg (1.3%) compared with 140mmHg (2.1%). Proper management of hypertension correlates with a 64% reduction in the development of heart failure.[3]

### Epidemiology

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Hypertension is one of the most prevalent pathologies in America affecting approximately 75 million adults or one in three US adults. Of these patients diagnosed with hypertension, only 54% have adequate blood pressure control.[4] The global prevalence of hypertension is 26.4% which accounts for 1.1 billion people, yet only one in five people have adequately managed blood pressure. One study found that prolonged hypertension eventually leads to heart failure with a median time of 14.1 years.

Meta-analyses have demonstrated a log-linear relationship between elevated blood pressure and increased risk of cardiovascular disease which increases substantially with age.

- In patients age 45-54 years old - 36.1% of males, 33.2% of females
- In patients age 55-64 - 57.6% of males and 55.5% of females
- In patients age 65-74 - 63.6% of males and 65.8% of females

- In patients age 75 or older 73.4% of males and 81.2% of females

Hypertension is slightly more common in women and conveys an increased risk of heart failure (3-fold) in comparison to men (2-fold). Women are more likely to have uncontrolled blood pressure and recent studies have suggested certain classes of antihypertensive medications may be less effective in women.

Certain ethnic groups have a higher predisposition for hypertension. The prevalence of hypertension among the African American population is among the highest of any ethnic group in the world at 45.0% for males and 46.3% for females. The rate is 34.5% for Caucasian males with 32.3% for females and 28.9% among Hispanic males with 30.7% for females.[5] In addition to the highest rate of hypertension, black Americans have a higher risk of developing heart failure, higher average blood pressure which develops at an earlier age, and are less amenable to treatment. All these factors contribute to increased mortality and a higher burden of disease.

## History and Physical

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The history and physical exam are a vital component of the management of hypertensive heart disease because most patients with hypertension do not have symptoms until late in the course when complications arise. Patients with left ventricular hypertrophy are asymptomatic; however, left ventricular hypertrophy can lead to anginal/ischemic chest pain due to increased oxygen demand required by the hypertrophied myocytes. Patients may present with exertional chest pain due to angina or coronary artery disease. Some patients may initially present with shortness of breath in the setting of acutely decompensated heart failure. Hypertensive patients are at risk for the development of atrial fibrillation. Patients may develop conduction anomalies which may present with palpitations, stroke, dizziness, syncope, or even sudden cardiac death.

History should focus on the severity, duration of hypertension, and current treatment. Hypertension is one of the predominant risk factors for the development of several cardiovascular diseases such as coronary artery disease, congestive heart failure, atrial fibrillation, cerebrovascular disease, peripheral arterial disease, aortic aneurysm, and chronic kidney disease. Patients should undergo assessment for the presence of other major modifiable cardiovascular risk factors such as hyperlipidemia, diabetes, alcohol use, smoking, drug usage, and other comorbid conditions such as chronic kidney disease or pulmonary disease. Diabetes is very common in this patient population and is a cardiovascular equivalent for the development of cardiovascular disease or chronic kidney disease. Hemoglobin A1C can be used to determine glycemic control. Sleep apnea, certain medications, tobacco, obesity, and alcohol use exacerbate hypertension and if uncontrolled may lead to treatment-resistant hypertension. A thorough family history should always be conducted assessing for premature cardiovascular death, sudden cardiac death, valvular disease, metabolic disease, stroke, or heart failure.

The physical exam is most often regular except in the setting of advanced cardiovascular disease. Auscultation of the heart may reveal an S3 or S4. An abnormal S4 sound denotes stiff, hypertrophic ventricles and is very specific to hypertensive heart disease. An abnormal S3 indicates thin, eccentric hypertrophy associated with systolic heart failure. Patients at risk of atherosclerotic disease may have carotid bruits or decreased peripheral pulses. Bilateral blood pressure reading should be conducted particularly in patients presenting with acute symptomatic disease to evaluate for aortic dissection. Blood pressure reading should be assessed at every visit, and ambulatory home blood pressure monitoring is recommended.

The ophthalmic exam is often underutilized in clinical practice but can provide insight into the extent and duration of hypertension. The ophthalmic exam should evaluate for the presence of AV narrowing or nicking, cotton wool spots, exudate and hemorrhage, and papilledema. Hypertensive retinopathy is often graded using the Keith-Wagener-Barker classification.

- Grade 1 - Mild nonproliferative retinopathy: mild narrowing or tortuosity of the retinal arterioles which indicates mild, asymptomatic hypertension
- Grade 2 - Moderate nonproliferative retinopathy: definite narrowing or constriction with AV nicking or sclerosis present which often indicates more elevated but likely asymptomatic chronic hypertension
- Grade 3 - Severe nonproliferative retinopathy: shows hemorrhage and exudative, cotton wool spots - blood pressure is often significantly elevated and symptomatic, but end-organ damage is minimal and usually reversible
- Grade 4 - Severe proliferative retinopathy: additionally demonstrates papilledema and retinal edema - blood pressure is persistently elevated, and patients will present with symptoms such as headache, visual disturbances, malaise, or dyspnea; these patients need urgent evaluation and close follow up as they have significant cardiovascular mortality
  - Grade 3 and 4 retinopathy require immediate referral to an ophthalmologist for evaluation and treatment of retinal disease

## Evaluation

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The workup for hypertensive heart disease should focus on evaluating for possible end-organ damage, assessing for other cardiovascular risk factors, and evaluating for possible secondary causes of hypertension if suggested by clinical features or physical exam. Patients should undergo evaluation for the presence of renal disease with baseline creatinine, diabetes, and glycemic control, hyperlipidemia, pulmonary disease, and other comorbid conditions. Obese male patients are at high risk for sleep apnea and should be screened using STOP-BANG and referred for evaluation of sleep apnea if warranted. All patients should be assessed with a 10-year cardiovascular risk calculator to calculate their cardiovascular risk and determine the level of intervention needed.

- EKG is the recommendation for initial evaluation of hypertensive heart disease - it may demonstrate ventricular hypertrophy, left axis deviation, or conduction abnormalities
  - EKGs have high specificity (75 to 95%) but low sensitivity (25 to 61%)[6] for the detection of cardiovascular disease
- Basic metabolic panel - sodium, potassium, calcium, blood urea nitrogen, creatinine
- Lipid Panel
- CBC
- Urinalysis with consideration for checking the urine protein albumin ratio
- TSH especially in the setting of atrial fibrillation

An echocardiogram is not recommended for the routine evaluation of hypertension as the presence of LVH does not change management. An echocardiogram should be considered in patients presenting with symptoms of heart failure, evaluation of young patients under 18, or patients

presenting with chronic, uncontrolled hypertension.

## Treatment / Management

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The American Cardiology Association/American Heart Association revised the previous JNC8 recommendations and released updated 2017 guidelines, classifying blood pressure into one of four categories: normal, elevated, stage 1 hypertension, or stage 2 hypertension.

- Normal blood pressure is defined as blood pressure as a systolic blood pressure under 120 mm Hg and a diastolic pressure less than 80mm Hg
- Elevated blood pressure occurs when systolic pressure ranges from 120-129mmHg with a diastolic pressure less than 80mm Hg
- Stage 1 hypertension is defined as systolic pressure ranges from 130-139mmHg or diastolic blood pressure between 80-89mmHg
- Stage 2 Hypertension has a systolic blood pressure greater than 140mmHg or diastolic blood pressure of 90mmHg or higher

The treatment of hypertension involves the use of antihypertensive medications:

- Thiazide diuretics especially chlorthalidone are the first line for hypertension - diuretics are necessary for patients with resistant hypertensive disease
- Angiotensin-converting enzyme inhibitors/ angiotensin receptor blockers are the first line for hypertension especially in patients with diabetes or chronic kidney disease
- Calcium channel blockers are the first line for hypertension
- Beta-blockers are not currently a recommendation for use in isolated hypertension - they are first-line for use in heart failure, ischemic heart disease, atrial fibrillation
- Vasodilators such as hydralazine are not first-line and should only be added when a third or fourth medication is needed for difficult to control hypertension or when contraindications exist for first-line medications

Typically two or more antihypertensives for adequate control especially in patients with stage 2 hypertension. Patients with stage 2 hypertension should be started on two antihypertensives then reassessed within thirty days for a response to therapy. Two medications from the same class should not be used, such as the use of both an ACEI and ARB. As per JNC 8 guidelines.

Heart failure management should be as per goal-directed medical therapy.

## Differential Diagnosis

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To make a diagnosis of hypertensive heart disease other causes of heart failure must first be ruled out. Ischemic cardiomyopathy is the most common cause of heart failure accounting for more than half of all heart failure. Thus all patients with new-onset heart failure should have an evaluation of coronary perfusion before making a diagnosis of HHD.

- Ischemic cardiomyopathy or coronary artery disease
- Hypertrophic cardiomyopathy
- Cardiomyopathy due to other etiologies like drugs or infection
- Valvular disorders such as aortic stenosis
- Sleep apnea

## Prognosis

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Hypertensive heart disease is a chronic progressive disease that carries a significantly increased risk of cardiovascular death. Hypertension is one of the predominant risk factors for the development of several cardiovascular diseases such as coronary artery disease, congestive heart failure, atrial fibrillation, cerebrovascular disease, peripheral arterial disease, aortic aneurysm, and chronic kidney disease. The overall prognosis of hypertensive heart disease is variable but depends on a variety of factors such as the specific manifestations of the disease, the presence of concomitant cardiovascular disease or risk factors, and other comorbid conditions. Cardiovascular risk calculators are available, and patients should be stratified into either high or low risk for cardiovascular events. Specific manifestations of HHD such as heart failure or atrial fibrillation carry a substantially increased risk of cardiovascular mortality. Patients with diastolic heart failure confer a similar risk and morbidity to patients with low ejection heart failure with 6-month mortality observed as high as 16%.<sup>[7]</sup>

## Complications

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Hypertensive heart disease is a syndrome of complication relating to the cardiovascular complications associated with chronic hypertension. Hypertension ranks as the most prevalent modifiable risk factor for premature cardiovascular disease and cardiovascular mortality and requires constant surveillance to identifying complications and slow their development. Prolonged hypertension promotes left ventricular hypertrophy which will eventually lead to heart failure (both systolic and diastolic). Eccentric hypertrophy leads to increased oxygen demand by the myocardium which can result in angina or ischemic symptoms. Hypertrophy of the muscle can disrupt conduction pathways predisposing to atrial fibrillation which leads to ischemic stroke.

Acute alterations in blood pressure can predispose patients to intracerebral hemorrhage or retinopathy. Prolonged hypertension is the predominant risk factor for the development of cardiac disease including atherosclerotic disease, heart failure, valvular disease, atrial fibrillation as well as cerebrovascular disease, chronic kidney disease, retinal disease, and metabolic disease. Nearly half of strokes and ischemic heart disease are attributable to sustained hypertension.

## Deterrence and Patient Education

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Hypertension is a chronic progressive disease that develops over many years, and patients require education on the risks of uncontrolled blood pressure. Automatic blood pressure cuffs are widely available and inexpensive and should be prescribed to every patient for home monitoring of their blood pressure. Patients should keep daily logs of their blood pressure; this is especially important for those at higher risk of disease progressions such as treatment-resistant hypertension or those with multiple concomitant risk factors for cardiovascular disease. Routine

measurement of blood pressure has been shown to improve compliance and allows for more patient involvement in the management of their disease.

Again, hypertension ranks as the most common modifiable risk factor for premature cardiovascular disease and often coexists with other major risk factors. Proper management requires identifying these risk factors and modification to slow the development of complications. An evaluation of the patient's lifestyle choices with particular attention to major modifiable risk factors should be conducted with a recommendation of tobacco cessation and decreased alcohol use, increased physical activity (three times a week) and low sodium diet (under 2 g/day) can all improve blood pressure control. Modification of specific lifestyle choices such as cessation of smoking or weight loss provides significantly more cardiovascular benefits than pharmacological treatment alone.

## Enhancing Healthcare Team Outcomes

Hypertensive heart disease is a chronic progressive disease that develops throughout many years. Public safety campaigns have educated the general population about the risks of hypertension and the development of cardiovascular disease. However, the asymptomatic nature of the disease leads to many people being unaware they have elevated blood pressure as such healthcare providers including nurse practitioners should encourage ambulatory blood pressure monitoring. Patients should be encouraged to make the necessary lifestyle changes to decrease the risk and progression of cardiovascular disease. Implementing multiple lifestyle modifications such as weight loss, low salt intake, and smoking cessation can provide a significant improvement in blood pressure control similar to that of initiating additional pharmacotherapy.

When initiating pharmacotherapy, a thiazide diuretic should be one of the first medications started. Patients with substantially elevated blood pressure may not achieve proper blood pressure control without the use of a diuretic. Diuretics, calcium channel blockers, and renin-angiotensin blockers exhibit synergistic effects allowing for better blood pressure control. Doses of antihypertensives have a nonlinear impact on blood pressure. A hypertensive medication exerts 75% of its maximal effect at only 50% of the max dose. So in patients whose blood pressure remains substantially elevated after hypertensive will benefit more from adding on another class of medication rather than maxing out the dose. Many hypertensive provide additional benefits that extend beyond their antihypertensive effects. Losartan is widely known to slow renovascular disease in patients with diabetes. However nighttime ingestion may reduce the risk of the development of diabetes mellitus type 2.[8] Chronotherapy or prescribing hypertensives differing times throughout the night has shown a reduction in cardiovascular complications.[9]

## Review Questions

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