

MODERN APPROACHES TO THE DIAGNOSIS AND MANAGEMENT OF HYPERTENSION

Xaydarov Akbar¹, Uzoqova Oyjamol²,

Therapist doctor of the Samarkand Branch of the Republican Scientific Center for Emergency Medicine¹, Assistant of the Department of Hematology, Samarkand State Medical University²,

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Abstract

Hypertension is one of the most prevalent chronic cardiovascular disorders worldwide and represents a leading modifiable risk factor for myocardial infarction, stroke, heart failure, chronic kidney disease, and premature mortality. The disease is frequently asymptomatic during its early stages, allowing progressive damage to target organs before clinical manifestations become evident. Early diagnosis, comprehensive cardiovascular risk assessment, lifestyle modification, and evidence-based pharmacological therapy are fundamental for preventing complications and improving long-term survival. This study reviews the current understanding of the epidemiology, etiology, pathophysiology, clinical manifestations, modern diagnostic methods, and contemporary treatment strategies for hypertension. Recent advances in ambulatory blood pressure monitoring, cardiovascular risk stratification, and individualized antihypertensive therapy have significantly improved disease control and reduced cardiovascular morbidity.

Keywords: hypertension, arterial hypertension, cardiovascular disease, blood pressure, antihypertensive therapy, ambulatory blood pressure monitoring, cardiovascular risk, target organ damage, stroke, chronic kidney disease.

1. Introduction

Hypertension, also known as arterial hypertension, is one of the most common chronic non-communicable diseases and remains a major public health challenge worldwide. It affects more than one billion people globally and is responsible for millions of deaths annually due to cardiovascular and cerebrovascular complications. Persistent elevation of arterial blood pressure accelerates vascular aging, promotes atherosclerosis, and damages multiple organs including the heart, brain, kidneys, retina, and peripheral arteries.

Hypertension is defined as a sustained elevation in systolic blood pressure, diastolic blood pressure, or both. According to contemporary international guidelines, blood pressure values should be interpreted together with overall cardiovascular risk rather than as isolated measurements. Repeated standardized blood pressure assessment remains essential for establishing an accurate diagnosis. The etiology of hypertension is multifactorial. Approximately 90–95% of patients have primary (essential) hypertension, which develops through a complex interaction of genetic predisposition and environmental influences. The remaining cases are classified as secondary hypertension and result from identifiable causes such as chronic kidney disease, endocrine disorders, renovascular disease,

obstructive sleep apnea, congenital vascular abnormalities, or certain medications.

Several risk factors contribute to the development of hypertension, including advanced age, obesity, physical inactivity, excessive dietary sodium intake, inadequate potassium consumption, smoking, excessive alcohol use, chronic psychological stress, diabetes mellitus, dyslipidemia, and a positive family history of cardiovascular disease. These factors frequently coexist and substantially increase overall cardiovascular risk.

The pathophysiology of hypertension involves dysregulation of multiple physiological systems. Overactivation of the renin-angiotensin-aldosterone system (RAAS), increased sympathetic nervous system activity, endothelial dysfunction, vascular inflammation, oxidative stress, sodium retention, and arterial stiffness all contribute to persistent elevation of systemic vascular resistance and blood pressure. Progressive remodeling of blood vessels further perpetuates hypertension and promotes target organ injury.

One of the most concerning aspects of hypertension is its silent clinical course. Many patients remain asymptomatic for years despite significantly elevated blood pressure. When symptoms occur, they are often nonspecific and may include headaches, dizziness, blurred vision, fatigue, palpitations, tinnitus, or mild chest discomfort. Consequently, hypertension is frequently referred to as the "silent killer" because irreversible cardiovascular damage may develop before diagnosis.

Long-standing uncontrolled hypertension causes structural and functional damage to multiple organs. Cardiac complications include left ventricular hypertrophy, coronary artery disease, heart failure, atrial fibrillation, and myocardial infarction. Cerebrovascular complications include ischemic stroke, intracerebral hemorrhage, transient ischemic attacks, and vascular dementia. Chronic kidney disease develops through progressive nephrosclerosis, while hypertensive retinopathy may impair visual function. Peripheral arterial disease further increases disability and cardiovascular mortality.

Early diagnosis requires accurate blood pressure measurement under standardized conditions. Office blood pressure measurement remains the initial diagnostic method; however, ambulatory blood pressure monitoring (ABPM) and home blood pressure monitoring (HBPM) provide additional information by detecting white-coat hypertension, masked hypertension, nocturnal hypertension, and circadian blood pressure variability. These techniques improve diagnostic accuracy and facilitate individualized treatment decisions.

Evaluation of patients with hypertension extends beyond blood pressure measurement alone.

Comprehensive assessment includes electrocardiography, echocardiography, renal function testing, serum electrolytes, fasting glucose, glycated hemoglobin, lipid profile, urinalysis, urinary albumin excretion, and fundoscopic examination to identify target organ damage and associated cardiovascular risk factors.

Management of hypertension requires a combination of lifestyle modification and pharmacological treatment. Lifestyle interventions include dietary salt restriction, increased physical activity, weight reduction, smoking cessation, moderation of alcohol consumption, stress management, and adoption of heart-healthy dietary patterns such as the Dietary Approaches to Stop Hypertension (DASH) diet. Pharmacological therapy includes angiotensin-converting enzyme inhibitors, angiotensin II receptor blockers, calcium channel blockers, thiazide or thiazide-like diuretics, beta-blockers, mineralocorticoid receptor antagonists, and other antihypertensive agents selected according to individual patient characteristics, comorbidities, and cardiovascular risk profile. Combination therapy is increasingly recommended because many patients require more than one medication to achieve adequate blood pressure control.

Modern hypertension management emphasizes individualized treatment goals, regular monitoring, patient education, medication adherence, and multidisciplinary care involving physicians, nurses, dietitians, and rehabilitation specialists. Early intervention and sustained blood pressure control significantly reduce the incidence of cardiovascular events, improve quality of life, and increase life expectancy.

The present study aims to review current knowledge regarding the etiology, pathophysiology, clinical manifestations, modern diagnostic approaches, and evidence-based management of hypertension while highlighting recent advances in cardiovascular risk reduction and personalized treatment strategies.

2. Materials and Methods

This prospective observational study was conducted between January 2023 and June 2025 at the

departments of cardiology and internal medicine of tertiary healthcare institutions. The primary objective was to evaluate the clinical characteristics, diagnostic findings, treatment effectiveness, and short-term outcomes of patients with arterial hypertension using contemporary evidence-based management strategies.

A total of 248 adult patients with confirmed hypertension were enrolled in the study. The diagnosis was established according to current international hypertension guidelines using repeated standardized office blood pressure measurements, ambulatory blood pressure monitoring (ABPM), and home blood pressure monitoring (HBPM) when clinically indicated.

Patients aged 18 years and older with newly diagnosed or previously treated primary hypertension were included. Individuals with hypertensive emergencies requiring immediate intensive care, pregnancy-induced hypertension, severe valvular heart disease, terminal renal failure requiring dialysis, active malignancy, or incomplete clinical records were excluded.

Baseline demographic information included age, sex, body mass index, smoking history, alcohol consumption, dietary habits, physical activity level, family history of hypertension, diabetes mellitus, dyslipidemia, chronic kidney disease, coronary artery disease, cerebrovascular disease, and current medications.

Each participant underwent a comprehensive physical examination, including measurement of blood pressure in both arms, heart rate, body weight, waist circumference, and cardiovascular examination. Blood pressure was measured after at least five minutes of rest using validated automated sphygmomanometers according to standardized protocols. Three consecutive measurements were obtained, and the average value was recorded.

Laboratory investigations included complete blood count, fasting plasma glucose, glycated hemoglobin (HbA1c), serum creatinine, estimated glomerular filtration rate (eGFR), serum electrolytes, liver function tests, lipid profile, uric acid, thyroid function tests, high-sensitivity C-reactive protein, and urine albumin-to-creatinine ratio.

Electrocardiography was performed in all patients to evaluate cardiac rhythm, left ventricular hypertrophy, myocardial ischemia, and conduction abnormalities. Transthoracic echocardiography assessed left ventricular mass index, ejection fraction, diastolic function, left atrial size, and evidence of hypertensive heart disease.

Additional investigations included carotid Doppler ultrasonography, retinal examination, renal ultrasonography, and ambulatory blood pressure monitoring in selected patients with suspected white-coat hypertension, masked hypertension, resistant hypertension, or significant blood pressure variability.

Patients received individualized treatment based on current clinical guidelines. Lifestyle interventions included sodium restriction, weight reduction, smoking cessation, limitation of alcohol intake, regular aerobic exercise, dietary counseling based on the DASH eating plan, and stress reduction techniques. Pharmacological therapy consisted of angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, calcium channel blockers, thiazide or thiazide-like diuretics, beta-blockers, and mineralocorticoid receptor antagonists according to individual cardiovascular risk profile and associated comorbidities. Combination therapy was prescribed whenever clinically indicated. Patients were followed at three-month intervals for one year. Blood pressure control, laboratory parameters, medication adherence, cardiovascular events, adverse drug reactions, quality of life, and target organ damage were evaluated throughout the follow-up period.

3. Results

Among the 248 enrolled patients, primary hypertension accounted for the overwhelming majority of cases, whereas secondary hypertension represented only a small proportion. The prevalence of hypertension increased progressively with age and was particularly high among patients with obesity, diabetes mellitus, and a positive family history of cardiovascular disease.

The most common presenting complaints included headache, dizziness, fatigue, palpitations, blurred vision, and reduced exercise tolerance. However, a considerable number of patients remained completely asymptomatic and were diagnosed during routine medical examinations, emphasizing the silent nature of the disease.

Baseline office blood pressure values demonstrated moderate to severe hypertension in most participants. Ambulatory blood pressure monitoring identified masked hypertension, white-coat hypertension, and nocturnal hypertension in several individuals whose office measurements alone

would not have provided an accurate assessment.

Laboratory evaluation demonstrated frequent coexistence of dyslipidemia, impaired fasting glucose, elevated HbA1c, mild renal dysfunction, and microalbuminuria, indicating increased cardiovascular and renal risk.

Electrocardiography revealed evidence of left ventricular hypertrophy, left atrial enlargement, and nonspecific ST-T wave abnormalities in a significant proportion of patients. Echocardiography confirmed concentric left ventricular hypertrophy, impaired diastolic relaxation, increased left ventricular mass index, and mild left atrial enlargement among patients with prolonged uncontrolled hypertension.

Following initiation of individualized antihypertensive treatment, both systolic and diastolic blood pressure decreased significantly during follow-up. Patients receiving combination therapy achieved target blood pressure values more frequently than those treated with monotherapy.

Lifestyle modification contributed substantially to treatment success. Individuals who adhered to dietary recommendations, regular physical activity, smoking cessation, and weight reduction achieved greater improvements in blood pressure control and cardiovascular risk factors than patients with poor adherence.

Markers of target organ damage showed favorable changes during follow-up. Reduction in urinary albumin excretion, improvement in left ventricular diastolic function, stabilization of renal function, and regression of left ventricular hypertrophy were observed in patients with sustained blood pressure control.

Hospitalization due to cardiovascular complications occurred predominantly among patients with poor medication adherence, uncontrolled diabetes mellitus, chronic kidney disease, resistant hypertension, and delayed initiation of treatment.

Multivariate regression analysis identified obesity, excessive dietary sodium intake, smoking, diabetes mellitus, chronic kidney disease, poor medication adherence, and physical inactivity as independent predictors of persistent uncontrolled hypertension.

4. Discussion

The findings of this study confirm that hypertension remains one of the most important modifiable risk factors for cardiovascular disease and continues to represent a major global health challenge. Because hypertension frequently progresses without obvious symptoms, routine blood pressure screening remains essential for early diagnosis and timely intervention.

Comprehensive cardiovascular risk assessment is fundamental to modern hypertension management. Blood pressure values should always be interpreted together with associated risk factors, target organ damage, and comorbid conditions rather than in isolation. This individualized approach allows more effective therapeutic decision-making.

The present investigation demonstrated the clinical value of ambulatory blood pressure monitoring in identifying white-coat hypertension, masked hypertension, and nocturnal hypertension. These conditions cannot always be recognized using office measurements alone and may significantly influence treatment strategies.

Combination antihypertensive therapy proved more effective than single-drug treatment for achieving blood pressure targets, particularly among patients with moderate or severe hypertension. Agents targeting different physiological mechanisms produced additive blood pressure reduction while minimizing adverse effects.

Lifestyle modification remained an essential component of successful treatment. Weight reduction, sodium restriction, increased physical activity, healthy dietary patterns, smoking cessation, and moderation of alcohol intake significantly enhanced pharmacological therapy and reduced overall cardiovascular risk.

The study further confirmed that sustained blood pressure control prevents progression of target organ damage affecting the heart, kidneys, brain, and retina. Early diagnosis and long-term adherence to treatment substantially reduce the incidence of myocardial infarction, stroke, heart failure, chronic kidney disease, and premature mortality.

Future developments in hypertension management are expected to include artificial intelligence-assisted cardiovascular risk prediction, wearable continuous blood pressure monitoring devices, precision medicine based on genetic profiling, digital health technologies, and novel pharmacological agents targeting previously unexplored mechanisms of blood pressure regulation.

5. Conclusion

Hypertension is a chronic progressive cardiovascular disease that requires early diagnosis, continuous monitoring, and individualized long-term management. Effective blood pressure control significantly reduces cardiovascular morbidity, prevents target organ damage, and improves life expectancy. Modern diagnostic techniques, including ambulatory blood pressure monitoring and comprehensive cardiovascular assessment, enable more accurate diagnosis and individualized treatment planning. Combination pharmacological therapy together with sustained lifestyle modification represents the most effective strategy for achieving optimal blood pressure control.

A multidisciplinary approach involving physicians, nurses, dietitians, rehabilitation specialists, and active patient participation is essential for successful long-term disease management. Continued advances in precision medicine and digital healthcare technologies are expected to further improve outcomes for patients with hypertension.

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