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An Overview: Hypertension Pathogenesis and Medical Treatment.

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Abstract

Arterial hypertension is a substantial cause of morbidity and mortality because of its association with renal disease, cerebrovascular disease, and coronary heart disease. Over the past ten years, the treatment of hypertension has changed as it has been obvious that there is no safe level of elevated blood pressure. Recent recommendations, notably those of the British Hypertension Society, state that treating isolated systolic hypertension is just as important as treating systolic and diastolic hypertension. Hypertension, or persistently high blood pressure, damages end organs over time and increases morbidity and mortality rates. Blood pressure is calculated as the sum of systemic vascular resistance and cardiac output. As a result, those with arterial hypertension may experience an increase in cardiac output, a rise in systemic vascular resistance, or perhaps even both. The lowering of cardiovascular risk is the main objective of antihypertensive therapy. Since lowering blood pressure alone only reduces the incidence of myocardial infarction by 20% to 25%, it is clear that improved defence is required. An ideal approach to lowering risk in hypertension patients may involve modifying their lifestyle, encouraging therapy adherence, and achieving target levels quickly and aggressively with the right drugs. In addition to using pharmaceutical techniques for blood pressure control, those factors known to increase the risk of hypertension should be aggressively handled. Maintaining a lower blood pressure, reducing salt intake, abstaining from alcohol, increasing exercise, ingesting more fruits and vegetables, and reducing total and saturated fat intake.

Key words: Blood pressure, Cardiovascular risk and antihypertensive.

Introduction

Due to its link to renal illness, cerebrovascular disease, and coronary heart disease, arterial hypertension is a significant source of morbidity and mortality. At least one in four persons in India are thought to have hypertension, although only around 12% of them are believed to keep their blood pressure under control. By 2025, India wants to have a 25% relative decrease in the prevalence of hypertension (high blood pressure). In order to do this, it's critical to strengthen initiatives like the India Hypertension Control Initiative (IHCI) and accelerate access to treatment services. The degree to which the kidneys, heart, and other target organs are affected affects the outcome. [1]

The degree to which the kidneys, heart, and other target organs are affected affects the outcome. Only 25% of hypertensive patients seem to have their blood pressure under control. In the case of isolated systolic hypertension, this is especially true. But as people age, isolated systolic hypertension becomes more common. In fact, the percentage of participants with isolated systolic hypertension—as opposed to systolic and diastolic hypertension—increases from 20% in those under 40 years old to 80% in those 60 to 69 years old, and to 95% in those over 80 years old. Systolic blood pressure is a good predictor of coronary and cerebrovascular risk, especially in older persons. As a result, the risk associated with it is garnering greater attention. Treatment for systolic hypertension reduces morbidity and successfully manages blood pressure, especially in elderly patients with a high risk profile.

The management of hypertension has altered over the past 10 years as it has become clear that there is no safe level of increased blood pressure. The treatment of isolated systolic hypertension is as critical to that of systolic and diastolic hypertension, according to recent guidelines, including those of the British Hypertension Society. [2] Now, 140/90 mm Hg is the cut-off point above which hypertension needs to be treated in order to avoid long-term consequences. Treatment of isolated systolic hypertension (systolic 140–159 mm Hg, diastolic 90 mm Hg) in Stage 1 hypertension does, in fact, lessen the occurrence of left ventricular

hypertrophy, a marker for future morbidity and mortality. Additionally, there is a 42% decrease in the risk of stroke and a decrease in the risk of dementia.

According to the hypertension best practises study, the target blood pressure level for treatment is 140/85 mm Hg. It is also known that in more than 37% of people under the age of 64 and more than 49% of people over the age of 65, high normal blood pressure (130-139/85-89 mm Hg) develops to Stage 1 hypertension (>140/>90 mm Hg).

According to the British National Formulary, take the following course of action: Blood pressure >220/>120 mm Hg requires emergency treatment. Blood pressure 200-219/110-119 mm Hg requires confirmation over 1-2 weeks before treatment. Blood pressure 160-199/100-109 mm Hg requires confirmation over 3-4 weeks before treatment. [3] The cumulative incidence of first cardiovascular events in people with high blood pressure is 10% in men and 4.4% in women over a ten-year period. Even high normal blood pressure is linked to a higher risk of dying from coronary or cerebral vascular causes. It is unknown if treating high-normal blood pressure would stop cardiovascular events.

Blood pressure regulation

Neurogenic control

The vasomotor centre consists of the nucleus tractus solitarius in the dorsal medulla (baroreceptor integration), the rostral section of the ventral medulla (pressor area), and additional centres in the pons and midbrain. The arterial baroreceptors increase afferent impulse activity in response to vessel wall distension. This, in turn, reduces efferent sympathetic activity while increasing vagal tone. The end result is bradycardia and vasodilation.

Renin-angiotensin system

Angiotensin is broken down by the protease renin to produce the inactive peptide angiotensin I. The angiotensin-converting enzyme (ACE) transforms the latter into the active octapeptide angiotensin II. The juxtaglomerular apparatus of the kidney is the primary source of renin despite the fact that the renin-angiotensin system is present throughout the body. [4] This device measures the sodium concentration in the distal tubular fluid as well as the renal perfusion pressure. Additionally, beta- and a-adrenoceptor activation both increase and reduce renin release. A negative feedback loop caused by high angiotensin II concentrations prevents renin secretion. Aldosterone, prostacyclin, and catecholamines are released along with smooth muscle contraction when angiotensin II activates on particular angiotensinAT1 and AT2receptors. The sodium-dependent regulation of arterial pressure is mostly controlled by the renin-angiotensin-aldosterone system.

Atrial natriuretic peptide

Atrial granules secrete atrial natriuretic peptide (ANP). It causes natriuresis, diuresis, and a little drop in blood pressure, while lowering plasma renin and aldosterone. Synaptic transmission from osmoreceptors is likewise altered by natriuretic peptides. ANP is produced in response to the activation of a trial stretch receptor. Because the left ventricle's wall contributes to the production of ANP, elevated filling pressures and individuals with arterial hypertension and left ventricular hypertrophy cause ANP concentrations to rise.

Adrenal steroids

Blood pressure is raised by glucocorticoids and minerals. This effect is mediated by either enhanced vascular reactivity (glucocorticoids) or salt and water retention (mineralocorticoids). In addition, by activating the receptors for pressor hormones like angiotensin II, glucocorticoids and mineralocorticoids boost vascular tone. All antihypertensive drugs must function by lowering cardiac output, peripheral vascular resistance, or both. [4, 5] The risk of coronary heart disease, stroke, congestive heart failure, and overall mortality is reduced by effective low-dose diuretic therapy. Dihydropyridines (such as nifedipine, nimodipine, and amlodipine) and nondihydropyridines (such as verapamil and diltiazem) are two categories of calcium channel blockers. Angiotensin AT1-receptor

antagonists are potent antihypertensive medications because angiotensin II stimulates the AT1-receptors that lead to vasoconstriction. Those factors known to enhance the risk of hypertension should be actively treated in addition to pharmaceutical methods for blood pressure control.

Sodium and water excretion

Blood pressure rises in conjunction with sodium and water retention. It is hypothesised that sodium increases intracellular calcium in vascular smooth muscle, which in turn increases vascular tone, through the sodium-calcium exchange process. [6] An improper relationship between pressure and sodium excretion resulting from decreased renal blood flow, decreased nephron mass, and elevated angiotensin or mineralocorticoids may be the main cause of salt and water retention.

Pathophysiology

Chronically elevated blood pressure or hypertension, damages end organs over time and raises morbidity and mortality rates. The sum of systemic vascular resistance and cardiac output determines blood pressure. Thus, individuals with arterial hypertension may have an increase in cardiac output, an increase in systemic vascular resistance, or maybe both. The cardiac output is frequently higher in younger age groups, but in elderly individuals, increased systemic vascular resistance and increased vasculature stiffness predominate. Greater a-adrenoceptor stimulation or greater production of peptides like angiotensin or endothelins may promote higher vascular tone. [7] The last mechanism is a rise in cytosolic calcium that causes vasoconstriction in vascular smooth muscle. Vascular remodelling is the process of an increase in vascular smooth muscle mass brought on by a number of growth hormones, such as endothelins and angiotensin.

When a person is young, the left ventricle generates a relatively modest pulse pressure, and the waves reflected by the peripheral vasculature mostly happen after systole has ended. This causes pressure to rise during the early stages of diastole, boosting coronary perfusion. The elastic arteries and aorta get stiffer with age, raising the pulse pressure. From early diastole to late systole, reflected waves travel. This contributes to left ventricular hypertrophy by increasing left ventricular afterload. Heart disease caused by coronary artery disease is strongly predicted by the widening of the pulse pressure with age. [8]

The control of blood pressure is mostly dependent on the autonomic nervous system. Norepinephrine is released more often and has greater peripheral sensitivity in hypertension patients. The reactivity to stressful stimuli has also risen. The setting of the bar reflexes and a reduction in baroreceptor sensitivity are further characteristics of arterial hypertension. At least some types of hypertension, such as renovascular hypertension, involve the renin-angiotensin system, which is suppressed by primary hyperaldosteronism. Patients who are older often develop low-renin hypertension. A myocardial infarction and other cardiovascular problems are more likely to occur in those with high renin hypertension.

Consequences and complications of hypertension

Heart disease and enlarged left ventricle are the effects of hypertension on the heart. Concentric and brought on by pressure overload, left ventricular hypertrophy. Muscle mass and wall thickness both raise, but ventricular volume does not. Diastolic dysfunction is hampered by left ventricular hypertrophy, which also slows ventricular relaxation and delays filling. An independent risk factor for cardiovascular disease, particularly sudden mortality, is left ventricular hypertrophy. The effects of hypertension depend on how severe it is. There is no cut off point for complications to happen because elevated blood pressure is linked to higher morbidity across the board. Chronic arterial hypertension is linked to and speeds up coronary artery disease, which causes myocardial ischaemia and myocardial infarction. In fact, compared to patients with normotension, people with untreated or poorly managed hypertension have myocardial ischaemia substantially more frequently. [9] Myocardial ischaemia is caused by two main factors: an increase in oxygen demand due to pressure and

a decrease in coronary oxygen delivery as a result of connected atheromatous lesions. An important contributor to the risk of dying from coronary artery disease is hypertension. Chronic pressure overload has the side effect of causing heart failure. Diastolic dysfunction may be the first sign, and it may proceed to overt systolic failure with heart congestion. Strokes, which can be caused by thrombosis, thromboembolism, or cerebral haemorrhage, are serious side effects of hypertension. [10, 11] Microalbuminaemia, the first sign of renal illness, may develop slowly and show itself in later years.

Long-term treatment of hypertension

All antihypertensive medications must reduce peripheral vascular resistance, cardiac output, or both in order to be effective. Thiazide diuretics, b-blockers, ACE inhibitors, angiotensin II receptor antagonists, calcium channel blockers, combined alpha and beta blockers, direct vasodilators, and some centrally acting medications like a2-adrenoceptor agonists and imidazoline 1 receptor agonists are among the drug classes that are most frequently prescribed. Adjusting one's lifestyle is the first step in treating hypertension. This includes a small salt restriction, weight loss in obese persons, cutting back on alcohol usage, and increasing activity. [12] When the aforementioned therapies have failed or when hypertension is already at a hazardous level (level 3) when it is first noticed, drug therapy is required.

Drug therapy

Diuretics

Effective low-dose diuretic treatment lowers the risk of coronary heart disease, stroke, congestive heart failure, and overall mortality. The risk of hypokalaemia and hypomagnesaemia is reduced when loop diuretics are coupled with a potassium-sparing diuretic, despite the fact that thiazides are the most often prescribed diuretic. Even at low doses, diuretics improve other anti-hypertensive drugs. [13] Use of potassium-saving diuretics lowers the risk of sudden death. Spironolactones, a common long-term hypertension side effect, gradually lower morbidity and death in patients with heart failure.

Beta-blockers

B-blockers are useful for treating angina, previous myocardial infarction, and excessive sympathetic tone. The inclusion of a diuretic or calcium channel blocker is frequently advantageous since a low dose reduces the likelihood of weariness, a negative effect of beta-blockade. B-blockade therapy is linked to signs of sadness, exhaustion, and sexual dysfunction, though. When assessing the therapeutic benefits, these adverse effects must be taken into account. B-blockers have become more widely utilised in recent years to treat heart failure, a known consequence of arterial hypertension. [14] They are efficient, but their administration in the context of heart failure must be done with extreme caution, beginning with extremely low dosages to prevent the heart failure's first deterioration.

Calcium channel blockers

Dihydropyridines (such as nifedipine, nimodipine, and amlodipine) and nondihydropyridines (such as verapamil and diltiazem) are two categories of calcium channel blockers. The peripheral vascular resistance is reduced by both groups, but verapamil and diltiazem have undesirable inotropic and chronotropic effects. While long-acting medications like amlodipine and slow-release nifedipine generate less sympathetic activation, short-acting dihydropyridines like nifedipine promote reflex sympathetic activation and tachycardia. The risk of sudden death appears to be increased by short-acting dihydropyridines.. [15]

Angiotensin converting enzyme inhibitors

First-line therapy increasingly includes the use of ACE inhibitors. Other than bilateral renal artery stenosis, they have comparatively little adverse effects and contraindications. Although unilateral renovascular hypertension can be treated with ACE medications, there is a chance of ischemic atrophy. Therefore, long-term, solely medicinal therapy is preferred to angioplasty or surgical renal artery restoration. Due to their ability to halt the progression of

renal impairment, ACE inhibitors are the first option of medication for diabetic and hypertensive patients. [16] ACE inhibitors are also among the first-choice medications for hypertension with heart failure. Ramipril lowered the risk of cardiovascular events even in the absence of hypertension, according to the HOPE study. Therefore, ACE inhibitors may have beneficial effects through means other than only lowering blood pressure.

Angiotensin II receptor blockers

Angiotensin AT1-receptor antagonists are potent antihypertensive medications because angiotensin II stimulates the AT1-receptors that lead to vasoconstriction. Compared to ACE inhibitors, losartan, valsartan, and candesartan are effective and less likely to make you cough. The most recent significant trial in hypertension is the LIFE study. More than 9000 patients were randomly assigned to receive either the b-blocker atenolol or the angiotensin receptor antagonist losartan [17]. Due to a higher decline in strokes, patients in the losartan arm had improved mortality and morbidity reduction. Additionally, losartan was more successful in lowering left ventricular hypertrophy.

alpha1-Adrenergic blockers

These medications lower blood cholesterol and lower peripheral vascular resistance without causing metabolic adverse effects. Compared to doxazosin, indoramin, and terazosin, prazosin has a shorter half-life. These medications have a high level of a1-adrenoceptor selectivity. It can be problematic if you experience drowsiness, postural hypotension, or infrequently tachycardia. A diuretic may need to be used if there is fluid retention. [18]

Direct vasodilators

Both hydralazine and minoxidil are vasodilators that work instantly. Due to the possibility of major adverse effects (hirsutism with minoxidil and lupus syndrome with hydralazine), their use has decreased.

Risk management

Those factors known to enhance the risk of hypertension should be actively treated in addition to pharmaceutical methods for blood pressure control. Two different measures exist. First, those that lower blood pressure, such losing weight, cutting down on salt, limiting alcohol use, exercising more, eating more fruits and vegetables, and consuming less total and saturated fat. [19] Second, those that lower cardiovascular risk, such as quitting smoking, switching from saturated to polyunsaturated and monounsaturated fats, increasing the consumption of oily fish, and consuming less overall fat. Other therapeutic options for hypertensive patients include aspirin and statin therapy because they have a very high risk of coronary artery disease. [20] In hypertensive individuals with well-controlled blood pressure, low-dose aspirin is also useful in preventing thrombotic events like stroke and myocardial infarction. As long as blood pressure is brought down to below 150/90 mm Hg, the danger of major bleeding is quite minimal. The advantages of lipid-lowering pharmacological therapy with statins in coronary heart disease and cerebrovascular disease, two illnesses typically linked to arterial hypertension, are well recognised.

Conclusion

The lowering of cardiovascular risk is the main objective of antihypertensive therapy. Since lowering blood pressure alone only reduces the incidence of myocardial infarction by 20% to 25%, it is clear that improved defence is required. An ideal approach to lowering risk in hypertension patients may involve modifying their lifestyle, encouraging therapy adherence, and achieving target levels quickly and aggressively with the right drugs. A successful hypertension CV risk reduction plan may comprise lifestyle changes, therapy adherence promotion, and early and aggressive goal level accomplishment by suitable drug selection. Global risk reduction, however, will soon overtake other forms of therapy as the industry standard. Strong evidence exists to support the idea that statins and newer blood pressure medications should be used together, especially in individuals with complex hypertension. Instead of focusing on specific risk factors or lowering blood pressure per se, antihypertensive

treatment should be based on a comprehensive assessment of risk. While decreasing blood pressure is unquestionably advantageous, the true goal must be the overall CV risk.

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