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# A Review: Drugs on Hypertension

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***Abstract:*** ***Hypertension it is linked to renal problems, stroke, and cardiovascular illnesses, hypertension—also referred to as high blood pressure—is a serious worldwide health concern. It is typified by consistently high arterial pressure, which is frequently brought on by lifestyle, environmental, and hereditary factors. Pharmacological and non-pharmacological methods are the mainstays of hypertension treatment. Depending on the demands of each patient, a variety of antihypertensive medication classes are frequently administered, such as diuretics, beta-blockers, calcium channel blockers, angiotensin-converting enzyme (ACE) inhibitors, and angiotensin II receptor blockers (ARBs). Novel therapeutic drugs including vasodilators and direct renin inhibitors have been investigated recently to enhance blood pressure management and lessen side effects. Combination treatments are also frequently used in order to maximize effectiveness and reduce medication resistance. Poor drug adherence is still a significant problem, even with the abundance of treatment alternatives available. This can result in uncontrolled hypertension and increased morbidity. Additionally, developments in personalized therapy and precision medicine have the potential to improve the management of hypertension. The pharmacological treatments for hypertension are thoroughly examined in this review, with a focus on their mechanisms of action, clinical effectiveness, and possible adverse effects. Healthcare providers may choose the best treatment plans for better patient outcomes and efficient blood pressure control by having a thorough understanding of the therapeutic landscape of antihypertensive medications.***

***Keywords: Hypertension, antihypertensive drugs, cardiovascular diseases, ACE inhibitors, beta-blockers, calcium channel blockers, angiotensin receptor blockers, diuretics, precision medicine, combination therapy.***

## I. INTRODUCTION

Paul Dudley White stated in 1931 they considered a widespread misperception regarding the clinical significance of essential hypertension: that the rise in blood pressure was necessary (or compensatory) to ensure adequate perfusion of target organs [1]. Unfortunately, this misconception persisted in published research—and in the minds of many physicians—until only a few years ago, despite Veterans Administration studies attesting to the benefits of antihypertensive medication. Since then, other studies have conclusively demonstrated that reducing blood pressure lowers cardiovascular morbidity and mortality across all severity levels of hypertension, even in high-risk normotensive individuals [2]. A Medline search using the phrase "essential hypertension," as of July 1, 2007, yielded 22,376 items, of which 3,430 were reviews. In this paper, we will focus on a few key and emerging topics that we believe are particularly relevant to physicians treating hypertensive cardiovascular disease, rather than attempting to review the entire body of literature [3].

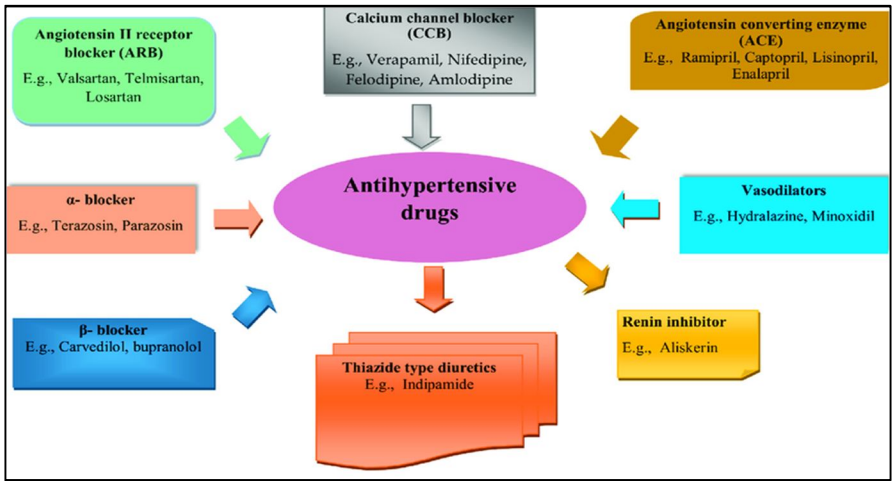


FIG.1 DRUGS USED FOR HYPERTENSION [4]

 

## II. ETIOLOGY

High blood pressure, sometimes known as hypertension, is a complicated illness with many underlying causes. According to its underlying aetiology, it is often divided into primary (essential) hypertension and secondary hypertension [5].

### *A. Primary Hypertension (Essential)*

About 90–95% of cases are of this kind, making it the most prevalent. It doesn't have a clear cause and develops gradually over time. Its onset is influenced by many risk factors: Genetics propensity: Susceptibility is increased by a family history of hypertension. Lifestyle Factors: Smoking, heavy alcohol use, eating a lot of salt, and not exercising all raise blood pressure. Obesity and Metabolic Syndrome: Vascular dysfunction and insulin resistance are linked to higher body weight [6].
Ageing: Because of vascular stiffness, the risk of hypertension rises with age. Stress and Hormonal Imbalances: Blood pressure management is impacted by long-term stress and changes in Neurohormonal regulation [7].

### *B. Hypertension in secondary*

This kind, which makes up 5–10% of instances of hypertension, is caused by an underlying medical issue. Typical reasons include: Renal Disorders: Blood pressure management may be hampered by renal artery stenosis and chronic kidney disease (CKD). Endocrine Disorders: Disorders that cause aberrant hormonal control include Cushing's syndrome, hyperthyroidism, hypothyroidism, and pheochromocytoma. Substances and Medicines: Blood pressure can be raised by corticosteroids, oral contraceptives, nonsteroidal anti-inflammatory medications (NASIDs) and illegal substances like cocaine. Cardiovascular Abnormalities: Heart conditions and aortic coarctation are two factors that lead to high blood pressure [8]. Blood pressure rises during sleep apnoea due to disturbances in oxygen levels and sympathetic nervous system activity [9]-[10].

## III. PATHOPHYSIOLOGY

Chronic hypertension, which is caused by intricate interplay between physiological, environmental, and hereditary variables, is typified by consistently high arterial blood pressure. Numerous processes in the pathophysiology lead to elevated cardiac output and vascular resistance [11].

### *A. Renin-Angiotensin-Aldosterone System (RAAS) function*

The control of blood pressure is significantly influenced by the RAAS. Angiotensin II, a strong vasoconstrictor that raises systemic vascular resistance, is produced in excess when this system is over activated in hypertension. Additionally, angiotensin II promotes salt and water retention by stimulating the adrenal glands to secrete aldosterone, which raises blood volume and blood pressure even more [12].

### *B. over activity of the Sympathetic Nervous System (SNS)*

By raising heart rate, myocardial contractility, and vasoconstriction, an overactive SNS exacerbates hypertension. In addition to causing arterial remodeling, which makes arteries stiffer and less sensitive to regulating systems, this increased sympathetic response results in a sustained rise in blood pressure [13].

### *C. Dysfunction of the Endothelium*

Hypertension impairs the endothelium, which controls vascular tone. Vasoconstriction and inflammation result from decreased nitric oxide (NO) production and elevated oxidative stress, which exacerbates hypertension and vascular injury [14].

### *D. Modified Water and Sodium Balance*

Fluid retention, which raises blood volume and pressure, is caused by the kidneys' dysregulation of sodium excretion. This is especially true for salt-sensitive hypertension, when eating too much sodium in the diet makes the illness worse [15].

### *E. Increased Peripheral Resistance and Vascular Remodeling*

Blood arteries undergo structural alterations as a result of chronic hypertension, including thickening of the artery walls and decreased flexibility. This maintains elevated blood pressure levels and raises total peripheral resistance.
Developing tailored treatments to control hypertension and avoid consequences like heart failure, stroke, and renal disease requires an understanding of these pathways [16].

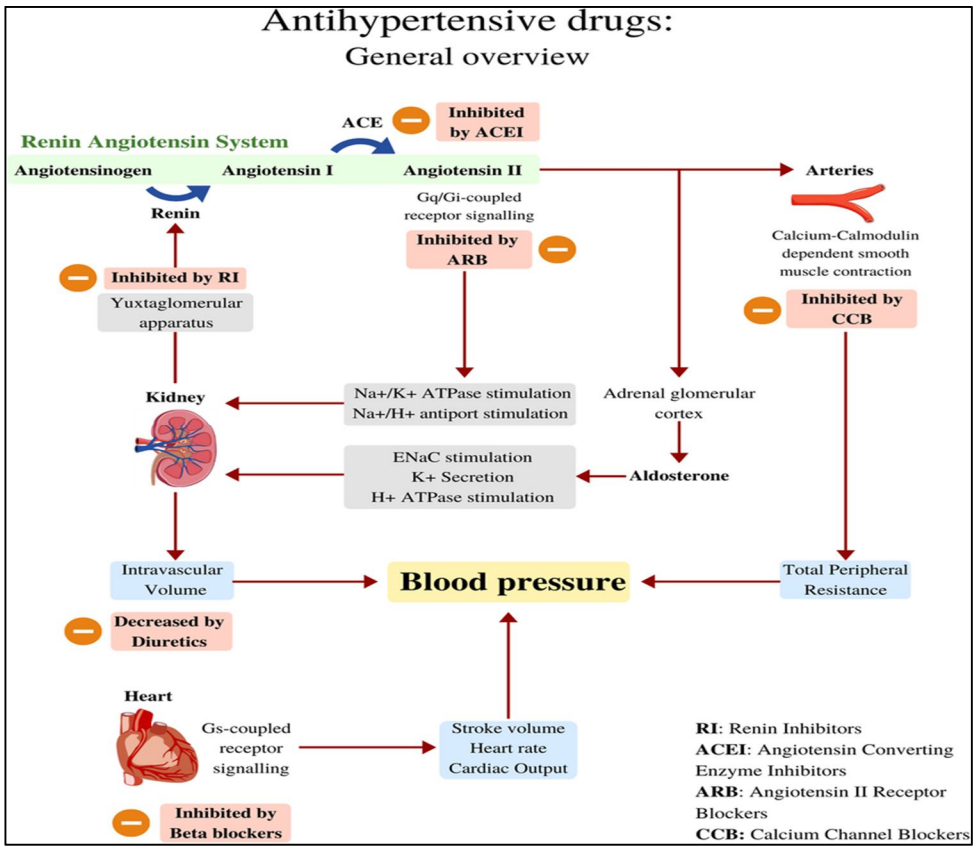


FIG.2 GENERAL OVERVIEW OF ANTIHYPERTENSIVE DRUGS [4]

## IV. HERBAL DRUGS USED FOR HYPERTENSION

Herbal medicines have been traditionally used to manage blood pressure through various mechanisms such as vasodilation, diuresis, and reduction of oxidative stress.

### *A. Garlic (Allium sativum)* [18]

- Mechanism: Contains allicin, which enhances nitric oxide (NO) production, leading to vasodilation and reduced blood pressure.
- Effect: Reduces systolic and diastolic blood pressure.
- Dosage: 600–900 mg/day or raw garlic consumption.

### *B. Hibiscus (Hibiscus sabdariffa)* [19]

- Mechanism: Acts as a natural ACE (Angiotensin-Converting Enzyme) inhibitor, reducing blood pressure.
- Effect: Lowers both systolic and diastolic BP.
- Dosage: Hibiscus tea (1–2 cups daily).

### *C. Ginger (Zingiber officinale)* [20]

- Mechanism: Enhances circulation and has calcium channel-blocking properties.
- Effect: Mild reduction in blood pressure and improved heart function.
- Dosage: 2–4 grams of ginger daily.

### *D. Arjuna (Terminalia arjuna)* [21]

- Mechanism: Improves heart function, reduces stress, and enhances NO production.
- Effect: Lowers blood pressure and improves cardiac output.
- Dosage: 250–500 mg extract daily.

*E. Brahmi (Bacopa monnieri)* [22]
- Mechanism: Reduces stress-induced hypertension by modulating neurotransmitters.
- Effect: Decreases both systolic and diastolic BP.
- Dosage: 300 mg/day.

*F. Ashwagandha (Withania somnifera)* [23]
- Mechanism: Reduces cortisol levels and has adaptogenic properties, lowering stress-induced hypertension.
- Effect: Mild antihypertensive effect.
- Dosage: 250–500 mg extract daily.

*G. Olive Leaf (Olea europaea)* [24]
- Mechanism: Contains oleuropein, which promotes vasodilation and reduces arterial stiffness.
- Effect: Lowers blood pressure.
- Dosage: 500–1,000 mg extract daily.

*H. Gokhru (Tribulus terrestris)* [25]
- Mechanism: Acts as a natural diuretic, reducing fluid retention and lowering BP.
- Effect: Reduces mild to moderate hypertension.
- Dosage: 250–500 mg extract daily.

*I. Fenugreek (Trigonella foenum-graecum)* [26]
- Mechanism: Lowers cholesterol and has mild vasodilatory properties.
- Effect: Reduces systolic and diastolic BP.
- Dosage: 5–10 grams-soaked seeds per day.

*J. Turmeric (Curcuma longa)* [27]
- Mechanism: Curcumin reduces inflammation and oxidative stress in blood vessels.
- Effect: Improves endothelial function and lowers blood pressure.
- Dosage: 500–1,000 mg curcumin extract daily.

## V. ALLOPATHIC DRUGS USED FOR HYPERTENSION

Allopathic antihypertensive drugs are classified based on their mechanism of action. These drugs are widely prescribed depending on the severity and cause of hypertension.

*A. Amlodipine (Calcium Channel Blocker - CCB)* [28]
- Mechanism: Blocks calcium influx in blood vessels, leading to vasodilation and reduced BP.
- Effect: Reduces systolic and diastolic pressure.
- Dosage: 2.5–10 mg/day.
- Side Effects: Swelling of the ankles, dizziness, flushing.

*B. Lisinopril (Angiotensin-Converting Enzyme Inhibitor - ACE Inhibitor)* [29]
- Mechanism: Blocks the formation of angiotensin II, reducing vasoconstriction and BP.
- Effect: Reduces blood pressure and protects kidneys.
- Dosage: 10–40 mg/day.
- Side Effects: Cough, hyperkalemia, dizziness.

*C. Losartan (Angiotensin II Receptor Blocker - ARB)* [30]
- Mechanism: Blocks angiotensin II receptors, preventing vasoconstriction.
- Effect: Lowers BP and reduces cardiovascular risk.
- Dosage: 25–100 mg/day.
- Side Effects: Dizziness, increased potassium levels.

*D. Hydrochlorothiazide (Diuretic - Thiazide Type)* [31]
- Mechanism: Increases urine output, reducing blood volume and BP.
- Effect: Lowers BP and prevents fluid retention.
- Dosage: 12.5–50 mg/day.
- Side Effects: Dehydration, electrolyte imbalance.

*E. Metoprolol (Beta-Blocker)* [32]
- Mechanism: Reduces heart rate and cardiac output.
- Effect: Controls BP and heart rate.
- Dosage: 25–100 mg/day.
- Side Effects: Fatigue, dizziness, depression.

*F. Clonidine (Centrally Acting Alpha Agonist)* [33]
- Mechanism: Reduces sympathetic nerve activity, lowering BP.
- Effect: Decreases both systolic and diastolic BP.
- Dosage: 0.1–0.3 mg/day.
- Side Effects: Dry mouth, sedation, drowsiness.

*G. Spironolactone (Aldosterone Antagonist - Diuretic Type)* [34]
- Mechanism: Blocks aldosterone, reducing sodium retention and BP.
- Effect: Lowers BP and prevents potassium loss.
- Dosage: 25–50 mg/day.
- Side Effects: Hyperkalemia, dizziness, gynecomastia.

*H. Diltiazem (Calcium Channel Blocker - CCB)* [35]
- Mechanism: Relaxes blood vessels and reduces cardiac workload.
- Effect: Controls BP and heart rate.
- Dosage: 120–360 mg/day.
- Side Effects: Constipation, swelling, fatigue.

*I. Furosemide (Loop Diuretic)* [36]
- Mechanism: Reduces fluid volume and BP by increasing urine output.
- Effect: Lowers BP in fluid-overloaded patients.
- Dosage: 20–80 mg/day.
- Side Effects: Dehydration, electrolyte imbalance.

*J. Valsartan (Angiotensin II Receptor Blocker - ARB)* [37]
- Mechanism: Blocks angiotensin II receptors, reducing vasoconstriction and BP.
- Effect: Lowers BP and protects heart and kidneys.
- Dosage: 80–320 mg/day.
- Side Effects: Dizziness, hyperkalemia.

## VI. COMPARATIVE STUDY HERBAL VS ALLOPATHIC DRUGS

High blood pressure, or hypertension, is a serious worldwide health issue that raises the risk of stroke, renal failure, and cardiovascular illnesses. Pharmacological therapies, which include both herbal and allopathic drugs, are used to treat hypertension. Herbal medications have drawn attention because of its natural origin, less side effects, and extra health advantages, while allopathic treatments offer quick and regulated results. In order to comprehend their function in the treatment of hypertension, this study theoretically compares herbal and allopathic medications in terms of their mechanisms of action, effectiveness, safety, and price [38].

## VII. MECHANISM OF ACTION

### *A. Herbal Medications*

These medications control blood pressure by a number of methods, including diuresis, ACE inhibition, and beta-blocking, vasodilation, and antioxidant benefits.

Nitric oxide (NO) generation is increased by garlic (*Allium sativum*), which lowers blood pressure and causes vasodilation.

Hibiscus (*Hibiscus sabdariffa*) relaxes blood vessels and reduces water retention by acting as an ACE inhibitor and natural diuretic.

The stress-relieving qualities of ashwagandha (*Withania somnifera*) and bacopa monnieri aid in the management of psychologically driven hypertension.

Strong antioxidant qualities found in turmeric (*Curcuma longa*) lower oxidative stress and enhance endothelial function [39].

### *B. Allopathic Medicines*

Allopathic drugs directly target the control of blood pressure through specific biochemical mechanisms.

Amlodipine and other calcium channel blockers prevent calcium from entering the heart and arteries, which causes vasodilation.

By preventing angiotensin I from being converted to angiotensin II, a strong vasoconstrictor, ACE inhibitors (like Lisinopril) reduce blood pressure.

Beta-blockers, such as metoprolol and atenolol, lower cardiac output and heart rate, which aids in the management of hypertension.

Diuretics, such as hydrochlorothiazide, decrease blood pressure and fluid retention by increasing urine output [40].

## VIII. FUTURE PERSPECTIVE OF STUDY

Integrating herbal and allopathic medicines will improve efficacy and reduce adverse effects in the management of hypertension in the future. Standardized herbal formulations can be established through molecular investigations, clinical trials, and advanced phytochemical research. Treatment plans may be improved by personalized medicine techniques that combine genetic analysis and AI-based medication recommendations. To provide safer and more efficient treatments, future research should concentrate on long-term cardiovascular benefits, bioavailability improvement, and herb-drug interactions [40].

## IX. CONCLUSION

In summary, while allopathic medications remain the cornerstone of hypertension management due to their rapid and clinically validated effectiveness, herbal remedies offer promising complementary benefits with fewer side effects and added cardio protective properties. A personalized and integrative treatment approach—considering patient-specific factors, lifestyle choices, and potential herb-drug interactions—may lead to safer, more effective, and sustainable blood pressure control. Future research should prioritize the standardization of herbal formulations and thorough clinical evaluations to ensure long-term safety and efficacy. A synergistic blend of modern medicine and traditional herbal therapies holds the potential to enhance the overall quality of hypertension care.

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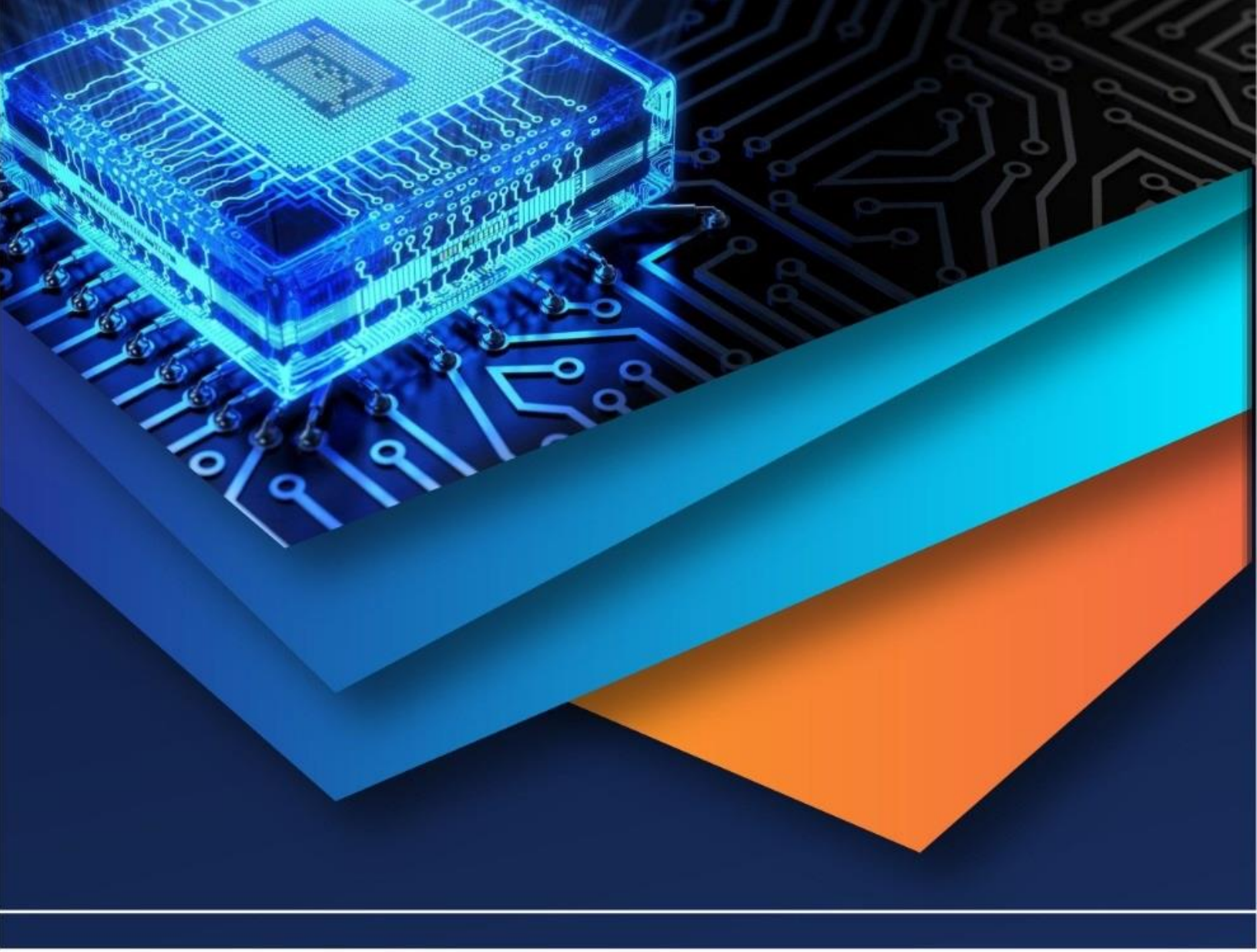

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