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Review on Diuretics: Used in the management of Hypertension

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ABSTRACT:
Hypertension, a significant global health issue, is particularly prevalent in low- and middle-income countries, such as India, where it affects approximately 25-30% of the population. The rising incidence of hypertension is largely attributed to urbanization, lifestyle changes, and an aging demographic. Among the various antihypertensive treatments, diuretics, especially thiazide diuretics, remain a cornerstone in the management of hypertension due to their proven efficacy, cost-effectiveness, and accessibility. Clinical practice guidelines from organizations like the Indian Society of Hypertension (ISH) consistently recommend thiazide diuretics as first-line therapy for mild to moderate hypertension. Diuretics work by stimulating the kidneys to eliminate excess sodium and water, reducing blood volume and lowering blood pressure. They are particularly valuable for managing primary hypertension and are often used in combination with other antihypertensive agents such as ACE inhibitors, calcium channel blockers, and angiotensin receptor blockers (ARBs) for enhanced therapeutic outcomes, especially in patients with coexisting conditions like diabetes and chronic kidney disease. Diuretics are classified into thiazide, loop, and potassium-sparing types, each with specific indications and mechanisms. Thiazide diuretics are most commonly prescribed for hypertension, while loop diuretics are used for severe fluid retention. This article explores the role of diuretics in hypertension management, emphasizing their clinical significance, benefits, and the strategic approach to treatment in the Indian health.

Keyword: Diuretics, Hypertension, Furosemide, Herbal plants, Clinical applications

I. INTRODUCTION:

Hypertension, or high blood pressure, is a significant public health issue worldwide, with particularly alarming rates in low- and middle-income countries such as India. According to the Indian Council of Medical Research (ICMR), the prevalence of hypertension in India was estimated to be around 25-30% in 2021, and it continues to rise steadily due to factors such as urbanization, lifestyle changes, and an aging population. Among the various classes of antihypertensive drugs, diuretics remain a cornerstone in the management of hypertension, particularly due to their effectiveness, cost-effectiveness, and availability.The use of diuretics in hypertension management in India is supported by evidence and clinical practice guidelines. The Indian Society of Hypertension (ISH) and other professional organizations consistently recommend thiazide diuretics as a first-line treatment for mild to moderate hypertension due to their proven efficacy in lowering blood pressure. These medications are particularly valuable in managing patients with primary hypertension, which constitutes a significant proportion of cases in India. Diuretics are also commonly prescribed in combination with other antihypertensive agents, such as ACE inhibitors, calcium channel blockers, and angiotensin receptor blockers (ARBs), to enhance efficacy, particularly in patients with higher cardiovascular risk. This approach has become even more significant with the rising incidence of co-morbid conditions like diabetes and chronic kidney disease that often accompany hypertension,

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demanding more comprehensive treatment strategies.Diuretics are a family of drugs that are frequently used to treat illnesses like renal problems, heart failure, and hypertension that include fluid retention. These medications stimulate the kidneys to remove extra water and salt (sodium) from the body. Diuretics decrease fluid retention, lower blood pressure, and reduce the symptoms of fluid excess by increasing the production of urine. They are sometimes called "water pills" since their main function is to improve fluid removal. Diuretics are classified into different categories based on their mechanism of action, including thiazide diuretics, loop diuretics, and potassium-sparing diuretics. Thiazide diuretics, such as hydrochlorothiazide, are commonly prescribed for the treatment of high blood pressure, while loop diuretics like furosemide are typically used for more severe cases of fluid retention associated with conditions like heart failure. Potassium-sparing diuretics, such as spironolactone, help prevent the loss of potassium, which can occur with other types of diuretics.

- **Rationale:**

Particularly in India, lies in their proven efficacy, affordability, and adaptability in addressing the growing burden of high blood pressure. With hypertension affecting an estimated 25-30% of the Indian population, largely due to urbanization, lifestyle changes, and an aging population, effective and accessible treatments are critical. Diuretics, especially thiazide diuretics, are recommended as first-line therapy by the Indian Society of Hypertension (ISH) and other professional bodies, owing to their consistent ability to lower blood pressure safely and effectively. Their low cost and availability make them particularly suitable for the Indian healthcare context, where access to medications can be limited. Additionally, diuretics are often used in combination with other antihypertensive drugs, such as ACE inhibitors and calcium channel blockers, to enhance treatment efficacy, particularly for patients with co-existing conditions like diabetes and kidney disease. As a result, diuretics not only provide an effective means of controlling hypertension but also contribute to broader public health goals by reducing the risk of complications like stroke, heart failure, and kidney damage. Their widespread use, therefore, plays a crucial role in mitigating the impact of hypertension in India, offering a practical solution to an escalating health crisis.

- **Mechanism of Action of Diuretics: -**

Diuretics work by altering how well the kidneys filter and reabsorb water and electrolytes. They cause increased urine production and the excretion of different electrolytes, including water and salt, by acting at different places inside the nephron, the kidney's functional unit.

1. Thiazide Diuretics (e.g., Hydrochlorothiazide)

The proximal convoluted of the nephron is the primary site of action for thiazide diuretics. They prevent salt and chloride from reabsorbed into the circulation from the urine by blocking the sodium-chloride symporter, commonly referred to as the Na+/Cl-cotransporter. Thiazides increase salt and water excretion by inhibiting this transporter, which decreases sodium reabsorption. Because the decrease in sodium reabsorption causes a small rise in calcium reabsorption, thiazides can be used to treat osteoporosis and kidney stones.

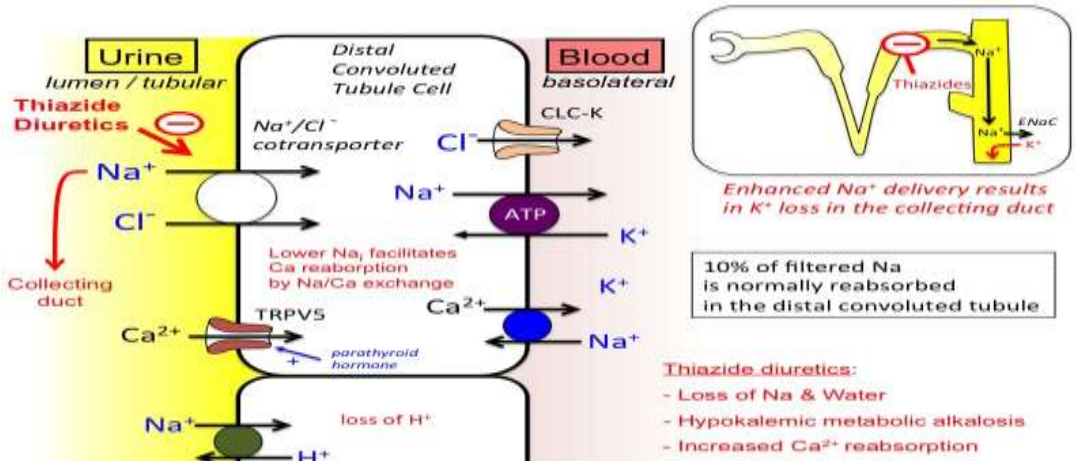

Figure:1 Mechanism of action of Thiazide Diuretics

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Mechanism: Decreased sodium and water reabsorption due to inhibition of Na+/Cl-co-transport in the distal tubule.
Effect: Lower blood volume and blood pressure due to increased excretion of water, salt, and chloride.

2. Loop Diuretics (e.g., Furosemide)

Strong diuretics known as loop diuretics act on the loop of Henle's thick ascending limb. These medications prevent sodium, potassium, and chloride ions from being reabsorbed from the urine by blocking the sodium-potassium-chloride (Na+/K+/2Cl-) symporter. By blocking this transporter, the kidney lacks the ability to concentrate urine, which results in a significant loss of water, potassium, sodium, and chloride. Heart failure, acute pulmonary inflammation, and chronic renal disease are among the illnesses for which loop diuretics are frequently used.

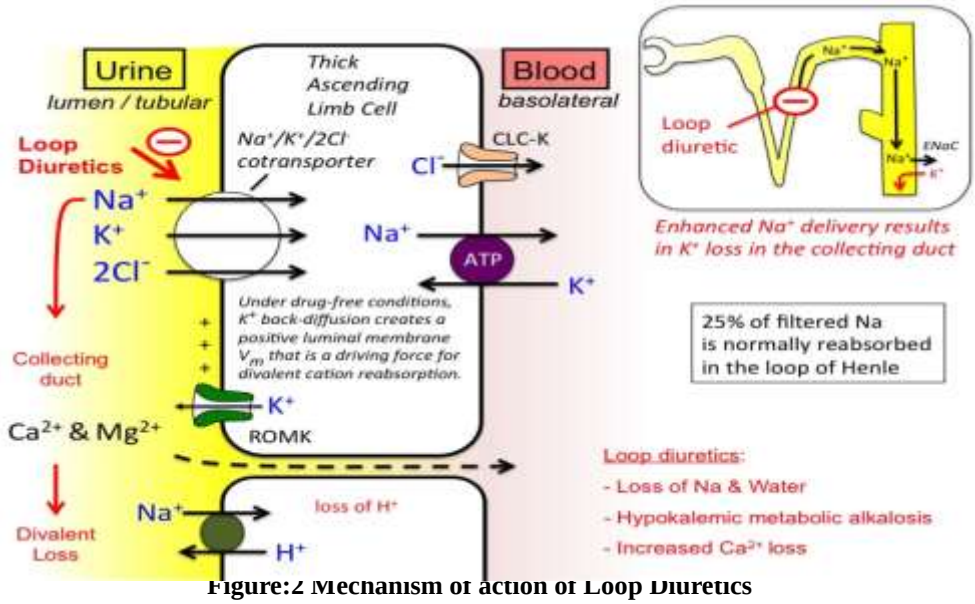

Figure:2 Mechanism of action of Loop Diuretics

Mechanism: Preventing sodium, chloride, and potassium reabsorption by inhibiting the Na+/K+/2Cl-co-transport in the thick ascending loop of Henle.
Effect: Deep diuresis, which lowers blood pressure and swelling while causing a quick loss of fluid.

3. Potassium-Sparing Diuretics (e.g., Spironolactone, Triamterene)

Potassium-sparing diuretics work at the collecting duct and distal convoluted tubule. There are two main types:

Aldosterone, a hormone which promotes potassium excretion and sodium reabsorption in the collecting duct, is inhibited by aldosterone antagonists, such as spironolactone. These diuretics increase sodium and water excretion while keeping potassium in reserve by inhibiting aldosterone, which inhibits sodium reabsorption and potassium excretion. By directly blocking sodium channels in the collecting duct, epithelial sodium channel blockers (such as triamterene and amiloride) increase sodium and water excretion without lowering potassium levels by blocking sodium reabsorption.

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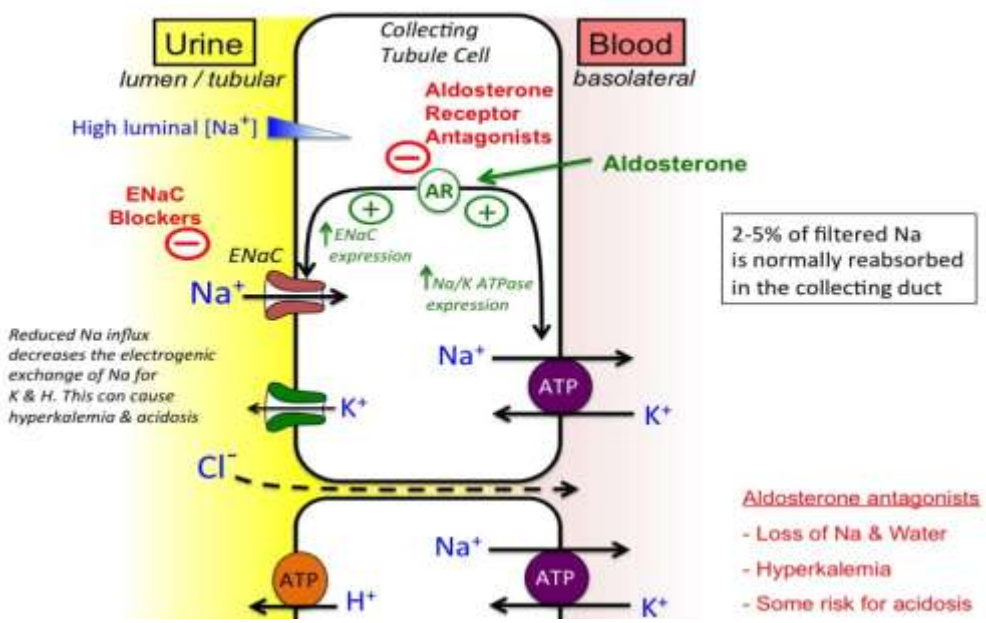

Figure:3 Mechanism of action of Potassium-Sparing Diuretics

Mechanism: mainly sodium channel inhibition (triamterene, amiloride) or aldosterone antagonistic effects (spironolactone).
Effect: In order to prevent hypokalaemia, mild diuresis that maintains potassium levels is frequently used in combination with other diuretics.

4. Carbonic Anhydrase Inhibitors (e.g., Acetazolamide)

Inhibitors of carbonic anhydrase work at the proximal convoluted tubule. They prevent carbon dioxide and water from being converted to bicarbonate and hydrogen ions by inhibiting the enzyme carbonic anhydrase. Bicarbonate reabsorption is decreased because of this inhibition, and bicarbonate, salt, and water are excreted more frequently. They are useful for glaucoma, altitude sickness, and metabolic alkalosis, although they are not frequently used for diuresis alone.

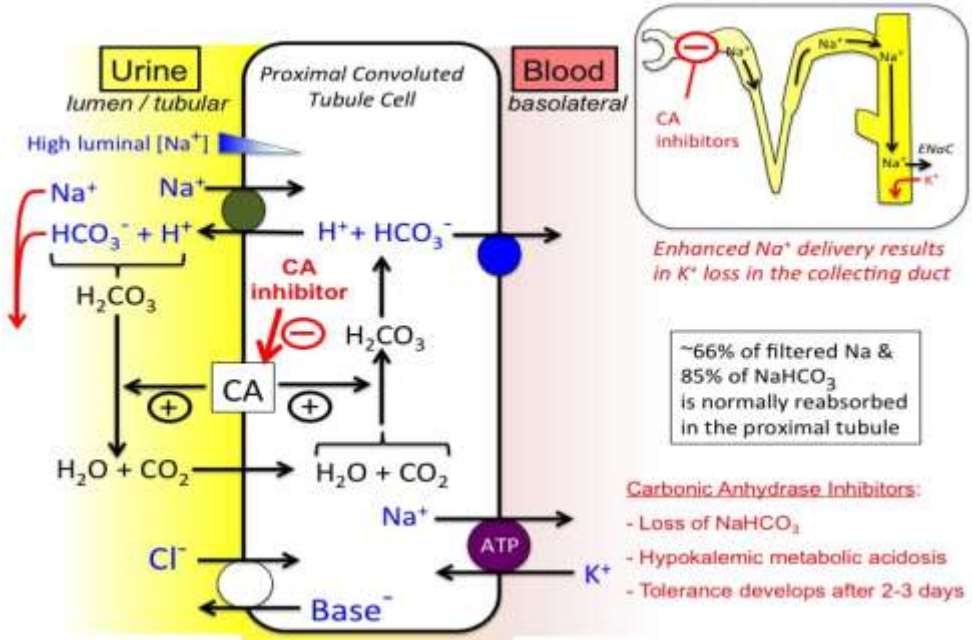

Figure:4 Mechanism of action of Carbonic Anhydrase inhibitors

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Mechanism: The proximal convoluted tubule's carbonic anhydrase is inhibited, which decreases bicarbonate reabsorption and increases fluid excretion.
Effect: Metabolic acidosis due to mild diuresis, mainly caused by bicarbonate loss.

5. Osmotic Diuretics (e.g., Mannitol)

Mannitol and other osmotic diuretics function by generating a pressure gradient inside the renal tubules. When added, mannitol remains in the tubule and pulls water into the urine by osmosis since it is not reabsorbed by the kidney. Urine production increases as a result, and brain and intraocular pressure decrease. Osmotic diuretics are commonly used for helping in the removal of harmful chemicals or in emergency conditions like brain swelling or glaucoma.

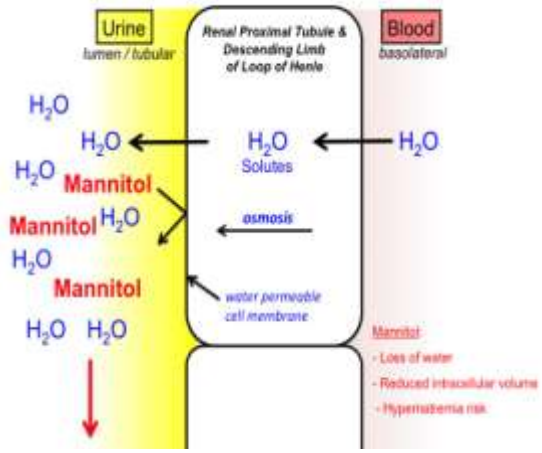

Figure:5 Mechanism of action of Osmotic Diuretics

Mechanism: Water reabsorption is inhibited by elevated osmotic pressure in the renal tubules.
Effect: Water is absorbed into the urine by osmosis, increasing urine production.
FUROSEMIDE: Their effect, safety, and role in hypertension

- **Introduction:**

Furosemide was first introduced to the medical market in 1967 under the brand name Lasix. The drug was initially used in the treatment of enema associated with congestive heart failure and other conditions, as well as to treat hypertension in patients who required a potent diuretic for blood pressure management.While furosemide is not typically considered a first-line treatment for primary hypertension, it plays a crucial role in managing secondary hypertension or cases where fluid overload contributes significantly to elevated blood pressure. Furosemide works by inhibiting the reabsorption of sodium and chloride in the loop of Henle, a part of the kidney's nephron, which results in a marked increase in the excretion of sodium, chloride, and water. This reduces blood volume and thus lowers systemic blood pressure.

- **Mechanism of Action**

Furosemide is a loop diuretic that is primarily used in the treatment of hypertension as well as conditions involving fluid retention, such as heart failure and chronic kidney disease. Its primary mechanism of action involves inhibiting the Na+/K+/2Cl− symporter in the thick ascending limb of the loop of Henle in the nephron of the kidney.By blocking this symporter, furosemide prevents the reabsorption of sodium (Na+), chloride (Cl−), and potassium (K+) from the urine back into the bloodstream. The inhibition of this transporter leads to an increase in the excretion of sodium, chloride, and water, which subsequently results in a reduction of blood volume and, consequently, blood pressure.

1. Inhibition of Na+/K+/2Cl− Symporter

In the kidneys, the Na+/K+/2Cl− symporter plays a vital role in sodium, chloride, and potassium reabsorption in the thick ascending limb of the loop of Henle. Furosemide inhibits this symporter, preventing the reabsorption of sodium and chloride back into the bloodstream. This inhibition disrupts the electrochemical gradient necessary for fluid reabsorption, leading to increased excretion of sodium and chloride along with water, which results in diuresis. By reducing sodium reabsorption, water follows osmotically into the urine, thus decreasing blood volume. Reduced blood volume is one of the key factors in lowering systemic blood pressure.

2. Reduction in Blood Volume

As furosemide increases the excretion of sodium and water, there is a corresponding reduction in blood volume, which lowers cardiac output and peripheral vascular resistance. These changes collectively contribute to a decrease in blood pressure. The reduction in blood volume is a major factor in managing conditions like heart failure and resistant hypertension, where excess fluid volume contributes to elevated blood pressure.

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3. Vasodilation

In addition to its diuretic effects, furosemide also induces mild vasodilation. The exact mechanism for this effect is not entirely understood, but it is thought to involve the release of prostaglandins or other vasodilatory mediators, such as nitric oxide. The vasodilatory effect further enhances the drug's ability to lower blood pressure by reducing systemicvascular resistance. This vasodilation can be particularly beneficial in patients with heart failure, where both fluid retention and high systemic vascular resistance contribute to elevated blood pressure.

4. Electrolyte Imbalances and Monitoring

Furosemide increases the loss of potassium (K+), magnesium (Mg2+), and calcium (Ca2+), in addition to sodium and chloride. These electrolyte imbalances can lead to hypokalaemia (low potassium), hypomagnesemia (low magnesium), and hypocalcaemia (low calcium), which can have serious consequences if not properly managed. Therefore, monitoring of electrolytes and renal function is essential during furosemide therapy, especially in long-term use.

5. Effects on Hypertension

In hypertension, particularly in cases of resistant hypertension or secondary hypertension (such as in patients with heart failure, chronic kidney disease, or cirrhosis), furosemide is an important therapeutic option. Its ability to reduce blood volume through diuresis and induce mild vasodilation helps in lowering elevated blood pressure, providing symptom relief, and improving quality of life for patients with fluid-related hypertension.

- **Role of Furosemide in Hypertension:**

Furosemide plays an important role in the management of hypertension in patients with specific comorbidities, such as heart failure, chronic kidney disease (CKD), and resistant hypertension.

1. Role of Furosemide in Resistant Hypertension

Resistant hypertension is defined as high blood pressure that remains above target despite the use of three antihypertensive drugs, including a diuretic. Furosemide is particularly useful in resistant hypertension, especially when the patient has concomitant fluid retention or volume overload. Furosemide's ability to promote diuresis (increased urine output) is central to its effect on lowering blood pressure by decreasing total body volume and reducing cardiac output.

2. Furosemide in Hypertension with Heart Failure

In heart failure, the primary issue is often fluid retention, which can worsen blood pressure and exacerbate symptoms such as enema, dyspnoea, and congestion. Furosemide is frequently used in patients with hypertensive heart failure, as it reduces fluid overload, leading to lower blood pressure and reduced symptoms. In these patients, managing blood pressure and controlling fluid balance are key to improving patient outcomes.

3. Furosemide in Hypertension with Chronic Kidney Disease (CKD)

Patients with **chronic kidney disease** often experience hypertension due to fluid retention, impaired renal function, and activation of the renin-angiotensin-aldosterone system (RAAS). Furosemide can help manage both fluid retention and elevated blood pressure in these patients, as its diuretic effects reduce both blood volume and systemic vascular resistance. However, its use must be carefully monitored due to the potential for worsening renal function and electrolyte imbalances.

4. Furosemide in Acute Hypertensive Crisis

In acute hypertensive crises, where blood pressure rises dramatically and quickly, furosemide can be used as an adjunct to other antihypertensive agents to manage associated fluid overload. While furosemide is not typically a primary agent for acute hypertension, it can help decrease blood volume in cases of fluid retention, which can contribute to acute elevation in blood pressure. Furosemide is often used in combination with other antihypertensive medications in this setting.

5. Electrolyte Imbalances and Renal Considerations

The use of furosemide is associated with several electrolyte imbalances, includinghypokalaemia, hyponatremia, and hypocalcaemia, which can be dangerous if not properly managed. Its potent diuretic effect increases the excretion of sodium, potassium, and chloride, making monitoring essential. Additionally, long-term use of furosemide can worsen renal function in some patients, particularly those with underlying kidney disease.

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- **Efficacy of Furosemide in Hypertension:**

It is most commonly used in cases of resistant hypertension, where blood pressure remains uncontrolled despite the use of multiple antihypertensive agents. A study demonstrated that furosemide effectively lowered blood pressure in patients with resistant hypertension, providing benefit when other treatments failed .Additionally, furosemide has shown efficacy in hypertension associated with heart failure and chronic kidney disease by reducing fluid overload, which contributes to elevated blood pressure. In these patients, furosemide helps manage both blood pressure and symptoms of fluid retention.However, furosemide is generally not considered a first-line treatment for uncomplicated hypertension. It is typically used in more complex cases, particularly when fluid retention is a significant factor, or in patients who do not respond to other standard antihypertensive therapies. Furosemide's diuretic effect, while effective, can lead to electrolyte disturbances, which makes it less suitable for long-term use in uncomplicated hypertension.

➢ **Herbal Plants Used as Diuretics**

The use of natural plant treatments is growing more and more popular worldwide, which has increased demand for knowledge about their properties and applications for the medicinal plant. Plant materials constitute the foundation of Indian traditional medicine, including Ayurvedic, Siddha, and Unani. The safety, effectiveness, and low price of herbal medications have made them more significant and popular in recent years.In certain situations, the therapeutic properties of medicinal plants are also affected by their interactions with other plants in their environment. The use of plant products as diuretic agents is one of their significant and well-established applications. Diuretics are medications that cause the kidneys to produce more urine. These substances mostly increase the renal excretion of sodium and either bicarbonate or chloride, and they also increase the excretion of water.

- **Herbaltreatment:**

One important source of diuretics is medicinal plants. Diuretics have been made from both mono and polyherbal ingredients. As said by one estimated 650 mono and polyherbal products, including pills, capsules, tinctures, and decoctions from more than 75 plants, are being used in medical treatments.

- **Herb used as adiuretics:**

Indians have long used herbs as diuretics, and major pharmaceutical companies have made them famous worldwide. Many plants have been strong diuretic action, and they are frequently used in traditional medicine to treat certain kidney conditions.

Multiple studies have shown that research on herbal plants used as diuretics in traditional medicine has grown recently and may be a helpful therapy for hypertension.

- **Some herbal plants exerting diuretic property**

❖ **Mangifera Indica**

Mangifera indica is a species of mango in the Anacardiaceous family. It is found in the wild in India and cultivated varieties have been introduced to other warm regions of the world. Itis the largest fruit-tree in the world, capable of a height of one-hundred feet and an averagecircumference of twelve to fourteen feet,sometimes reaching twenty.[26]The diuretic activity of Mangifera indica bark extract was investigated by Shree Devi, using ethyl acetate, ethanol, and water extracts for evaluation. The study was conducted on rats with a body weight range of 175–200 grams, and urine volume was measured at intervals of 1, 2, 4, 6, and 24 hours. Furosemide (20 mg/kg, i.e.) and mannitol (100 mg/kg, i.e.) were used as positive controls. The extracts were administered orally at a dose of 250 mg/kg body weight. The results showed that the Na+/K+ ratio was highest in the aqueous extract, followed by the ethanol and ethyl acetate extracts.

Figure 6: **Mangifera Indica**

❖ **Achyranthes aspera**

Achyranthes aspera Linn (Marantaceae), commonly known as Apa marga in Ayurveda and

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isfound as a weed that has been traditionally usedfor several ailments.The plant is traditionally used for various therapeutic purposes, including as a diuretic, spermicidal, anti-allergic,cardiovascular agent, nephroprotective, antiparasitic, hypoglycaemic, analgesic, and antipyretic. In the current study, the methanolic extract of the whole Achyranthes aspera plant was evaluated for its diuretic potential. The diuretic effect was assessed using the method of Lipschitz et al., with furosemide as the standard drug. The rats treated with the methanolic extract exhibited a notable diuretic effect compared to the control group, although it was less potent than that of furosemide. A significant increase in the renal clearance of sodium, potassium, and chloride ions was observed in both the treated and standard drug groups.

Figure 7: **Achyranthes aspera**

❖ **Bixa Orellana**

Bixa Orellana is a shrub or small tree widely cultivated for the seeds or as an ornamental in West Indies, tropical Asia, and Africa. The plant has long been used by American Indians to make body paint, especially for the lips, which is the origin of the plant's nickname, lipstick tree. Extracts of theleaves of Bixa possess antimicrobial activityagainst Gram positive microorganisms, withmaximum activity against Bacillus pumilus. Bixa leaves have been traditionally used to treat malaria and Leishmaniasis. In this study, the dried leaf powder of Bixa Orellana was subjected to successive Soxhlet extraction using petroleum ether, methanol, and water. The diuretic activity of these extracts was evaluated in Wistar rats using a standard method. The results showed that the methanolic extract of Bixa Orellana leaves exhibited significant diuretic activity, as evidenced by an increase in total urine output and enhanced excretion of sodium, potassium, and chloride ions.

Figure 8: **Bixa Orellana**

❖ **Taraxacum officinale**

Taraxacum officinale, the common dandelion(often called "dandelion"), is a floweringherbaceous perennial plant of the familyAsteraceae. Dandelion is commonly used as afood. The leaves are used in salads and teas, whilethe roots are sometimes used as a coffeesubstitute. Dandelion leaves and roots have beenused for hundreds of years to treat liver,gallbladder, kidney, and joint problems. Dandelion has traditionally been used as a remedy for conditions like eczema and cancer. In experimental studies conducted on mice, high doses of an aqueous extract of dandelion leaf (2 grams per kg body weight) demonstrated diuretic activity like that of furosemide. Given that dandelion is also a rich source of potassium, some researchers believe it may help replenish potassium levels lost through diuresis.

Figure 9:**Taraxacum officinale**

❖ **Lepidium sativum**

Lepidium sativum known as garden cress belongs to the family Brassicaceae. The seeds and

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leaves of the plant contain volatile oils. Garden cress seeds are bitter, thermogenic,depurative, rubefacient, galactagogue, tonic, aphrodisiac,ophthalmic, antiscorbutic, antihistaminic, and diuretic. They are useful in the treatment of asthma, coughs with expectoration, poultices forsprains, leprosy, skin disease, dysentery,diarrhoea, splenomegaly, dyspepsia, lumbago,leucorrhoea, scurvy, and seminal weakness. Seedshave been shown to reduce the symptoms ofasthma and improve lung function in asthmatics.The main chemical constituents of Latium areflavonoids, coumarins, glycosides, glucosinolate,glucotropaeolin, triterpenes, sterols and alkaloids.Both the aqueous and methanolic extracts of L. sativum significantly increased urine volume. These extracts enhanced sodium excretion, with the aqueous extract also increasing potassium excretion. The diuretic effect of the extracts was found to be comparable to that of hydrochlorothiazide, which was used as a reference drug. Additionally, the methanolic extract offered the added benefit of conserving potassium.

Figure 10: **Lepidium sativum**

❖ **Allium sativum**

Allium sativum, commonly known as garlic,belongs to the family Liliaceae and genus Allium. Garlic is traditionally used for various purposes, including as a carminative, aphrodisiac, expectorant, and disinfectant in treating pulmonary conditions. Its oil is used as an anthelmintic and rubefacient. Garlic has been found to help lower blood pressure and cholesterol levels, in addition to exhibiting strong antimicrobial properties. When purified fractions of Allium sativum are administered intravenously, they produce a significant biphasic and natriuretic response. Chloride ions follow the natriuretic pattern, but potassium ions do not. No changes were observed in arterial blood pressure or electrocardiogram.

Figure11: **Allium sativum**

- **Clinical Applications of Diuretics in Hypertension**

1. First-Line Treatment for Primary Hypertension

- Thiazide diuretics are commonly used as the first-line treatment for primary (essential) hypertension in adults, especially in older patients. They are effective in lowering blood pressure and preventing complications such as stroke and heart failure.

2. Combination Therapy for Uncontrolled Hypertension

- Diuretics are often combined with other antihypertensive agents, such as ACE inhibitors, ARBs, calcium channel blockers, or beta-blockers, to improve blood pressure control in patients whose blood pressure remains elevated despite monotherapy.

3. Hypertension with Heart Failure

- Loop diuretics (e.g., furosemide, bumetanide) are critical in managing hypertension in patients with heart failure, particularly those with fluid retention or congestive symptoms. They help control both hypertension and fluid overload, reducing symptoms of heart failure.

4. Hypertension with Chronic Kidney Disease (CKD)

- Loop diuretics are used in patients with hypertension and chronic kidney disease, especially when there is fluid retention or edema. Diuretics help control both blood pressure and manage fluid overload in these patients.

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5. Management of Resistant Hypertension

- In patients with resistant hypertension (those whose blood pressure remains above target despite the use of three or more antihypertensive agents), diuretics such as spironolactone are often added to the treatment regimen to help achieve better blood pressure control.

6. Hypertension in Elderly Patients

- Thiazide diuretics are particularly beneficial for elderly patients, especially those with isolated systolic hypertension (a common condition in older adults), as they help lower both systolic and diastolic blood pressure.

7. Diuretics for Hypertension with Obesity

- In overweight or obese individuals with hypertension, diuretics can help control blood pressure and reduce the cardiovascular risk associated with obesity. Thiazide diuretics are often used in combination with other medications for this purpose.

8. Hypertension with Diabetes

- Thiazide diuretics are frequently used to treat hypertension in diabetic patients, though care is needed to monitor for electrolyte imbalances. They can help control blood pressure in this population and reduce the risk of diabetic complications.

9. Pregnancy-related hypertension and hyperglycemia

- Diuretics, particularly in combination with other agents, are used in managing hypertension in pregnant women with pre-eclampsia or gestational hypertension, although they are used cautiously to avoid electrolyte disturbances.

II. CONCLUSION:

Diuretics play a crucial role in the management of hypertension by effectively reducing blood pressure. They work by increasing the excretion of sodium and water from the body, leading to a decrease in blood volume and, consequently, blood pressure. While thiazide diuretics are most commonly prescribed due to their proven efficacy and safety profile, other types like loop and potassium-sparing diuretics may be used based on specific patient needs. However, like all medications, diuretics come with potential side effects, including electrolyte imbalances and dehydration, which require careful monitoring. Overall, when used appropriately, diuretics remain a cornerstone in the treatment of hypertension, often in combination with other antihypertensive agents, to achieve optimal blood pressure control and reduce the risk of cardiovascular events.Inmodern day to day practice diuretics can be usedas a first line therapy in hypertensive patients.Herbal medicines are in great demand in thedeveloped as well as in the developing countriesfor primary health care because of their widebiological and medicinal activities, higher safetymargins and lesser costs. The review has includedthe botanical characteristics of the plant whichhelps in identification of the plant, Ethnobotanywhich give traditional use of the plant, and thereported activities of the plant. However, thenumber of studies is limited and we recommendthat further studies to be conducted to confirmreported activities. Such evidence is needed toprovide scientific credence to the folklore use oftraditional medicines and even be helpful in thedevelopment of future medicines and treatmentsand treatment guidelines. By this review, it can beconcluded that in the core of the nature there areso many plants which possess potent diureticactivity. Herbal medications are free from sideeffects and toxicity unlike the allopathicmedicines. The current review projected toprovide an overview of knowledge adjoining theherbal medicines used as diuretics.

REFERENCE:

[1]. National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases & Stroke (NPCDCS), Government of India, 2021.
[2]. Indian Council of Medical Research (ICMR) Annual Report 2021.
[3]. Katzung, B. G., Masters, S. B., & Trevor, A. J. (2018). Basic & Clinical Pharmacology (14th ed.). McGraw-Hill Education.
[4]. Weiner, I. D., & Wingo, C. S. (2018). "Diuretics: Mechanism of Action and Clinical Applications." The New England Journal of Medicine, 379(3), 213-223.
[5]. Kemp, R. W., & Lacy, C. F. (2019). Diuretics: Mechanism of Action and Clinical Uses. In Basic and Clinical Pharmacology (14th ed., pp. 273-278). McGraw-Hill Education.
[6]. McDonough, A. A., & Fenton, R. A. (2016). Mechanisms of action of diuretics.

Comprehensive Physiology, 6(1), 337-378.DOI: 10.1002/cphy.c150036

[7]. Boehm, M., & Wuerzner, G. (2019). Diuretics in clinical practice: Indications, pharmacology, and therapy. Clinical Kidney Journal, 12(4), 497-507.DOI: 10.1093/ckj/sfz091

[8]. Harris, L. (1967). The development of furosemide (Lasix) in the treatment of heart failure. Journal of Cardiology.

[9]. Moser M, Egan BM.Diuretics in the treatment of hypertension: Pharmacology and clinical experience. Hypertension. 2017;69(6):1073-1078. doi:10.1161/HYPERTENSIONAHA.117.09634.

[10]. Whelton PK, Carey RM, Aronow WS, et al. 2017 High Blood Pressure Clinical Practice Guidelines. J Am Coll Cardiol. 2018;71(19):e127-e248. doi:10.1016/j.jacc.2017.11.006.

[11]. Moser M, Egan BM. Diuretics in the treatment of hypertension: Pharmacology and clinical experience. Hypertension. 2017;69(6):1073-1078. doi:10.1161/HYPERTENSIONAHA.117.09634.

[12]. Brater DC. Pharmacology of diuretics: Clinical applications. Kidney Int. 1999;56(5):1878-1885.

[13]. He J, Whelton PK. The epidemiology of hypertension in the early 21st century: A global perspective. Curr Opin Cardiol. 2004;19(4): 356-361. doi:10.1097/01.hco.0000136427.77345.77.

[14]. Furberg CD, Psaty BM. Furosemide and the management of hypertension. Cardiovasc Drugs Ther. 1997;11(6):821-826.

[15]. Whelton PK. Epidemiology of hypertension in the United States: A review of the current understanding of the role of hypertension in the development of cardiovascular disease and the clinical management of hypertension. Am J Hypertens. 2000;13(9):1051-1058. doi:10.1016/s0895-7061(00)00253-6.

[16]. Kammerer S, et al. Furosemide in hypertension: Pharmacological effects and clinical use. J Hypertens. 1991;9(7):539-543.

[17]. Flory JH, et al. Furosemide and its role in the treatment of hypertension and fluid overload conditions. J Cardiovasc Pharmacol. 1992;20(2):289-298.

[18]. Bakris, G. L., & Williams, M. (2001). Furosemide in hypertensive crisis. Journal of Hypertension, 19(6), 1191-1195.

[19]. Hill, S. (2017). Furosemide in the treatment of heart failure. Journal of Cardiac Failure, 23(5), 391-398.

[20]. Hill's article emphasizes that furosemide remains a cornerstone therapy in heart failure

[21]. Latham, A. W., & Pendergraft, M. (2018). The role of loop diuretics in hypertension management. American Journal of Hypertension, 31(7), 770-779.

[22]. Wang, H. R., & Patel, N. D. (2012). Furosemide in the management of acute hypertensive crises: A review of its role and effectiveness. Hypertension Research, 35(5), 675-680.

[23]. Lapi, F., & Martino, C. (2012). Electrolyte disturbances and kidney function with long-term use of furosemide. Kidney International, 82(7), 719-726.

[24]. Ruilope, L. M., et al. (2009) "Use of furosemide in resistant hypertension: a randomized controlled trial."Hypertension. 2009;53(3): 475-482.DOI: 10.1161/HYPERTENSIONAHA.108.129447

[25]. Ruilope, L. M., et al. (2009) "Use of furosemide in resistant hypertension: a randomized controlled trial."Hypertension. 2009;53(3): 475-482.DOI: 10.1161/HYPERTENSIONAHA.108.129447

[26]. Wilson, M. R., Vasan, R. E., et al. (2005) "Furosemide for hypertension in patients with chronic heart failure."Journal of the American College of Cardiology (JACC). 2005;45(7): 1195-1202.DOI: 10.1016/j.jacc.2004.09.069

[27]. Daugirdas, S. R., Feldman, R. D., et al. (2006) "Furosemide in hypertension with chronic kidney disease."Kidney International. 2006;69(8): 1461-1467.DOI: 10.1038/sj.ki.5000235

[28]. Katz, E., et al. (1994) "Comparison of furosemide and hydrochlorothiazide in the treatment of hypertension."Hypertension. 1994;24(3): 346-352.DOI: 10.1161/01.HYP.24.3.346

[29]. Chauhan C etal. Germination, emergence, anddormancy of Mimosa pudica. Weed

Biology andManagement 2009; 9(1): 38–45.
[30]. Barrar FSK. Text book of pharmacology. NewDelhi: S. Chand; 2003, p298.
[31]. Chopra RN, Nayar SL, Chopra, LC. Glossary ofIndian Medicinal Plants (Including thesupplement). New Delhi, India: Council ofScientific and Industrial Research; 1986, p 845.
[32]. Wright C J et al. Herbal medicines as diuretics, areview of the scientific evidence. Journal ofEthnopharmacology 2007; 114(1):1-31.
[33]. Shree Devi MS. Acute toxicity and diureticactivity of Mangifera indica Linn bark extracts.International Journal of Pharma and Biosciences 2011; 2(3):141-146.
[34]. Srivastav S et al. Diuretic activity of wholeplant extract of Achyranthes aspera Linn.European Journal of Experimental Biology 2011;1(2):97-102.
[35]. Fleischer T C et al. Antimicrobial activity of theleaves and seeds of Bixa orellana. Fitoterapia2003; 74 (1–2): 136–138.
[36]. Radhika B et al. Diuretic activity of Bixaorellana Linn leaf extracts. Indian journal ofNatural Products and Resources 2010; 1(3):353-355.
[37]. Blumenthal M, Goldberg A, Brinckmann J.Herbal Medicine: Expanded Commission EMonographs. Newton,MA: IntegrativeMedicine Communications; 2000, p78.
[38]. Racz-KE et al. The action of Taraxacumofficinale extracts on the body weight and diuresis of laboratory animals. Planta Medica1974; 26:212-217.
[39]. Archana N P, Anita A M. A study on clinicalefficacy of Lepidium sativum seeds in treatmentof bronchial asthma. Iranian Journal ofPharmacology and Therapeutics 2006; 5: 55–59.
[40]. Patel U et al. Evaluation of diuretic activity ofaqueous and methanol extracts of Lepidiumsativum Garden Cress (Cruciferae) in Rats.Tropical Journal ofPharmaceutical Research2009; 8:215-219.
[41]. Pantoja C V et al. Purification and bioassaysof a Diuretic and natriuretic fraction from garlic(Allium sativum). Journal of Ethnopharmacology2000; 70: 35-40.
[42]. Whelton PK, Carey RM, Aronow WS, et al. (2018). 2017 ACC/AHA Hypertension Treatment Guidelines. Journal of the American College of Cardiology, 71(19), e127–e248.
[43]. The ACCOMPLISH Trial Investigators. (2008). A comparison of amlodipine and benazepril in the treatment of hypertension in high-risk patients. NEJM, 359(23), 2446-2459.
[44]. The SOLVD Investigators. (1991). Effect of enalapril on mortality and the development of heart failure in asymptomatic patients with reduced left ventricular ejection fraction. NEJM, 325(5), 293-302.
[45]. The HEAAL Study Group. (2015). High-dose furosemide versus standard-dose furosemide in patients with heart failure and chronic kidney disease: A randomized controlled trial. JACC, 65(4), 388-396.
[46]. The PATHWAY-2 Investigators. (2015). Effect of spironolactone on blood pressure in treatment-resistant hypertension: A randomized, double-blind, placebo-controlled trial. Lancet, 386(10008), 2059-2066.
[47]. The Systolic Hypertension in Europe (Syst-Eur) Study Group. (1997). Health benefits of treating isolated systolic hypertension in the elderly. NEJM, 336(17), 1105-1114.
[48]. The ALLHAT Officers and Coordinators for the ALLHAT Collaborative Research Group. (2002). Major outcomes in high-risk hypertensive patients randomized to angiotensin-converting enzyme inhibitor or calcium channel blocker vs diuretic. JAMA, 288(23), 2981-2997.
[49]. he VADT Study Group. (2009). Intensive glucose control and cardiovascular outcomes in patients with type 2 diabetes. NEJM, 360(13), 129-139.
[50]. The CHIPS Study Group. (2015). Antihypertensive treatment for mild hypertension during pregnancy. NEJM, 372(5), 430-441.