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# A Study on Drug Utilization Evaluation of Antihypertensives in the General Medicine Department of a Tertiary Care Hospital

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***Abstract:***
***Background:*** *Hypertension is one of the leading risk factors for cardiovascular, cerebrovascular and renal disease. Once hypertension is diagnosed, starting antihypertensive therapy on a long term basis along with regular follow up is important. Standardizing treatment guidelines and conducting drug utilization studies at regular intervals help physicians to prescribe drugs rationally. The aim of the study was to assess the drug utilization of antihypertensives in a tertiary care hospital.*
***Method:*** *A cross sectional prospective observational study was carried out in in-patient department of MediCiti Hospital. Patients who have been diagnosed with hypertension as per JNC-8 guidelines and patient receiving or prescribed with antihypertensive drugs were included.*
***Results:*** *A total of 300 prescriptions were analysed. The majority of the patients were males comprised 52.66%, whereas the females comprised 47.33%, with most of the patients suffering from stage-I hypertension. The most commonly prescribed class of drugs were Angiotensin Receptor Blockers, followed by Calcium Channel Blocker's and Beta Blockers. With regard to patient therapy, 82.33% received single drug therapy, whereas 17.66% received multiple drug therapy.*
***Conclusion:*** *Our study shows that the most commonly prescribed drug classes involved were ARB's followed by CCB's and most attention should be paid to guidelines for treatment of hypertension with compelling indications and treatment of hypertension cases based on stage of hypertension.*
***Keywords:*** *Hypertension, Drug utilization evaluation, Stage I hypertension, Angiotensin Receptor Blockers, Calcium Channel Blockers, Beta Blockers, Single Drug Therapy, Multiple Drug Therapy.*

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## I. Introduction

Hypertension represents an enormous global public healthcare challenge. The World Health Organization (WHO) as projected that 1.5 billion people globally are likely to suffer from hypertension by 2025[1]. The overall prevalence of hypertension in India is estimated at 29% [2]. Cardiovascular diseases are responsible for 1.5 million deaths in India annually. Hypertension is linked to 57% of all stroke deaths and 24% of all coronary event deaths [3]. Hypertension is ranked as third most important risk factor attributable disease burden in South Asia [4]. Hypertension is arguably the single most important risk factor for cardiovascular, cerebro vascular and renal disease that can be modified by timely detection as well as decisive therapeutic intervention.

The guidelines for the treatment of hypertension are put forward by the Joint National Committee (JNC) on detection, evaluation and treatment of blood pressure. The Indian guidelines, endorsed by the cardiology society of India, the hypertension society of India, and the Indian College of Physicians, closely follow the JNC Guidelines (JNC6 and JNC7)[5,6]. These guidelines are updated from time to time, based on evidence emanating from basic and clinical research, and guide physicians to select the most appropriate antihypertensive agent in a patient. Pharmacoepidemiological studies such as Drug Utilization and Prescription pattern studies are an important research tool by which the impact that such guidelines have on the selection of therapeutic agents can be assessed and analysed. It has been observed that evidence-based clinical research is not adequately incorporated into clinical practice [7], which can in turn result in suboptimal patient health-care practices. The objective of this study is to observe the pattern of utilization of antihypertensives in a tertiary care teaching hospital and relate the findings to current standard treatment guidelines.

**DEFINTION**

Hypertension is defined as persistent elevation of arterial blood pressure. The Eighth Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of high blood pressure (JNC8) classifies adult blood pressure as shown in table.1

**TABLE 1.1 :** JNC 8 HYPERTENSION CLASSIFICATION

| Category | Systolic (mm Hg) | Diastolic (mm Hg) |
|---|---|---|
| Normal | 90-119 | 60-79 |
| Prehypertension | 120-139 | 80-89 |
| stage 1 Hypertension | 140-159 | 90-99 |
| Stage 2 Hypertension | >160 | >100 |
| Isolated systolic Hypertension | >/=140 | <90 |

A hypertensive crisis (blood pressure greater than 180/120 mmHg) may be categorized as either a hypertensive emergency (extreme blood pressure elevation with acute or progressive target organ injury)[8].

Pathophysiologically, hypertension can be classified into two main groups.

1. Essential or Primary Hypertension- where the cause for rise in blood pressure is not known.
2. Secondary Hypertension- where rise is due to renal disease e.g. chronic diffuse glomerulonephritis, pyelonephritis; due to some vascular disease e.g. renal artery disease or due to some endocrinal disorders e.g. phaechromocytoma, Cushing's syndrome and primary aldosteronism.

Clinically, hypertension can be divided into three stages e.g. mild, moderate and severe hypertension. The diastolic blood pressure between 90-104 mm Hg is graded as mild, 105-114 mm Hg is graded as moderate and above 115 mm Hg is graded as severe hypertension. The person having systolic blood pressure more than 160 mm Hg with low diastolic blood pressure is termed as 'Isolated Systolic Hypertension' commonly seen in elderly person [9].

**DRUG UTILIZATION EVALUATION**

**DEFINITION:**

According to WHO, Drug Utilization Evaluation is defined as the marketing, distribution, prescription and use of drugs in society, with special emphasis resulting medical, social and economic consequences [10]. Drug Utilization Evaluation (DUE) is an ongoing authorized and systematic quality improvement process to:

- To optimize drug use by developing criteria and standards.
- To educate clinicians and other health care professionals (HCP), to increase appropriate drug use.
- To provide feedback of results obtained during study to clinicians and others.
- To review drug use.
- To analyse prescription pattern[11

**The DUE cycle**

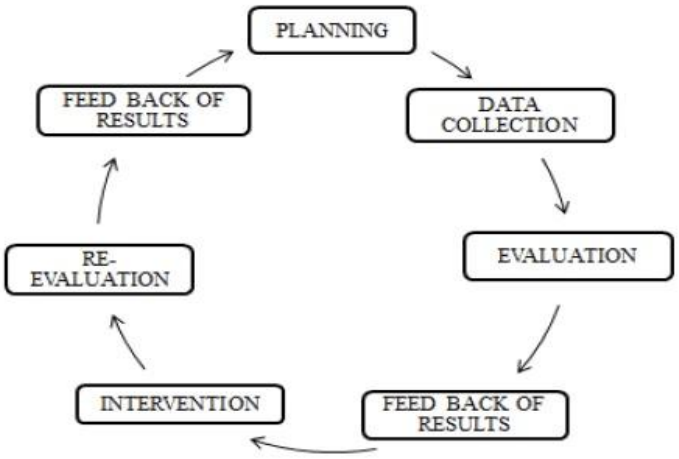


**FIG.1.1.** THE DUE CYCLE

**TYPES OF DUE**

Drug focused: Drug utilization evaluation of a single drug (e.g. Ceftriaxone) or a class of drugs (e.g. cephalosporins) is tested.

Indication focused: Evaluation of drug or drugs that is used for specific indications is examined for their use.

Quantitative: It includes collecting, organizing and estimation of drug usage in figures in the pattern of drug acquisition, prescribing, dispensing, consumption and distribution.

Qualitative: This type of DUE helps in evaluating the quality of drug therapy and its outcomes by comparing practice with predetermined criteria standards [12,13].

**Role of Pharmacist in DUE**

- Performing pilot studies, collection of data, analyzing collected data and writing a report.
- To plan, organize and implement a DUE program.
- Developing, supervising and coordination of DUE program.
- To promote goals and objectives of DUE.
- To document outcomes of program, its effectiveness and cost benefits.
- To present DUE results that obtained at meetings and conferences.
- To educate hospital about DUE and its use [14].

The improvement process of MUE has its application in all settings where pharmaceutical care is provided. Pharmacists play a major role in the overall process of a DUE program because of their experience in the area of pharmaceutical care. DUE affords pharmacists the opportunity to identify the trends in prescribing in patients such as those with asthma, diabetes or high BP. Pharmacists then along with the physician and other health care teams take required action to improve the drug therapy [15]. Regular evaluation of the antihypertensive prescribing patterns are essential these days due to the growing epidemic of hypertension, increasing number of new antihypertensive drugs and the increasing number of drug combinations that are introduced into the market each year together with alteration in guidelines[16].

**Hypertension Pharmacotherapy and Guidelines**

Antihypertensive drugs are prescribed mainly to reduce the morbidity and mortality caused by hypertension and its complications. Many a time, patients require more than one drug for effective control of hypertension. Various classes of antihypertensive drugs like diuretics, inhibitors of the Rennin-Angiotensin system, calcium channel blockers (CCB) and beta blockers (BB) have been shown to reduce complications of hypertension and may be used for initial drug therapy[17]. The available guidelines recommend different goal BP levels and drug treatment options according to patients individual clinical need (see table.2)

**TABLE 1.2:** GUIDELINE COMPARSIONS OF GOAL BP AND INITIAL DRUG THERAPY FOR ADULTS WITH HYPERTENSION

| Guideline | Population | Goal BP, mmHg | Initial drug treatment options |
|---|---|---|---|
| JNC 8: 2014 Hypertension Guideline [18] | General ≥60 y | <150/90 | Nonblack: thiazide-type diuretic, ACEI, ARB, or CCB; black: thiazide-type diuretic or CCB |
| | General <60 y | <140/90 | |
| | Diabetes | <140/90 | |
| | CKD | <140/90 | ACEI or ARB |
| +ESH/ESC 2013[19] | General nonelderly | <140/90 | Diuretic, BB, CCB, ACEI, or ARB |
| | General elderly <80 y | <150/90 | |
| | General ≥80 y | <150/90 | |
| | Diabetes | <140/85 | ACEI or ARB |
| | CKD no proteinuria | <140/90 | |
| | CKD + proteinuria | <130/90 | |
| Canadian Hypertension Education Program (CHEP) 2014[20] | General <80 y | <140/90 | Thiazide, BB (age <60y), ACEI (nonblack), or ARB |
| | General ≥80 y | <150/90 | |
| | Diabetes | <130/80 | ACEI or ARB with additional CVD risk ACEI, ARB, thiazide, or dihydropyridine CCB without additional CVD risk |
| | CKD | <140/90 | ACEI or ARB |
| American Diabetes Association (ADA) 2013[21] | Diabetes | <140/80 | ACEI or ARB |
| Kidney Disease: Improving Global Outcome (KDIGO) 2012[22] | CKD, no proteinuria | ≤140/90 | ACEI or ARB |
| | CKD + proteinuria | ≤130/80 | |
| NICE 2011[23] | General <80 y | <140/90 | <55 y: ACEI or ARB |
| | General ≥80 y | <150/90 | ≥55 y or black: CCB |
| International Society for Hypertension in Blacks (ISHIB) 2010[24] | Black, lower risk | <135/85 | Diuretic or CCB |
| | Target organ damage or CVD risk | <130/80 | |
| Korean Society of Hypertension Guidelines for the Management of Hypertension 2013[25] | Elderly (>65 years) | <140/90 | ACEIs, CCBs and diuretics; BBs should be limited to special scenarios |
| | Diabetes | <140/85 | |
| | Stroke, CAD and CKD | 140/90 | Combination therapy of ARBs, CCBs and diuretics |

**NEED OF STUDY**

- To review the drug use of antihypertensive drugs like ARB's, ACEI's, CCB's, Diuretics and Beta Blockers in general medicine department of the hospital.
- To develop criteria and standards for the drugs included in the study which describe optimal drug use.
- Preparation and implementation of guidelines for the drugs included in the study.
- To promote appropriate and rational drug use based on measurement of outcomes.

## II. Drug Profiles

**ANGIOTENSIN RECEPTOR BLOCKERS**

Angiotensin II receptor blockers(ARBs) are medications that block the action of Angiotensin II by preventing Angiotensin II receptors on the muscles surrounding blood vessels. As a result, blood vessels enlarge (dilate) and blood pressure is reduced.

**TELMISARTAN**:
Telmisartan is an Angiotensin II receptor blocker used in the therapy of hypertension.
PHARMACOLOGICAL CLASS:
Telmisartan belongs to the class of Angiotensin II antagonists.
AVAILABLE DOSES AND INDICATION:
Oral: Hypertension
Adult : Initially, 40mg once daily, may be adjusted to 20-80 mg once daily if needed.
Renal impairment: severe impairment or on hemodialysis: Initially, 20 mg once daily.
Hepatic impairment: Mild to moderate: Max: 40 mg once daily.
Severe: Contraindicated.
Oral: Cardiovascular risk reduction
Adult: 80 mg once daily.
Renal impairment: severe impairment or on hemodialysis: Initially, 20mg once daily.
Hepatic impairment: Mild to moderate. Max: 40 mg once daily
Severe: Contraindicated.
MECHANISM OF ACTION:
Telmisartan is a non peptide $AT_1$ angiotensin II receptor antagonist. It exerts antihypertensive activity by preventing Angiotensin II from binding to $AT_1$ receptors thus inhibiting the vasoconstriction and aldosterone-secreting effects of Angiotensin II.
PHARMACOKINETICS:
Absorption: Rapidly absorbed from the GI tract. Food may slightly decrease the bioavailability. Absolute bioavailability: Dose-dependent(approx. 42% after 40-mg dose: 58% after 160-mg dose). Time to peak plasma concentration: Approx 0.5-1 hr.
Distribution: Volume of distribution : 500L. plasma protein binding: >99%.
Metabolism: Undergoes conjugation w/ glucoronic acid to form inactive metabolites.
Excretion: Via faeces(97%, as unchanged drug). Terminal elimination half-life: Approx 24 hr.
Onset: 1-2 hr.
Duration: Up to 24 hr.
ADVERSE DRUG REACTION:
Dizziness, fatigue, headache, sinusitis, upper respiratory tract infection, pharyngitis, UTI, back pain, myalgia, diarrhea, abdominal pain, dyspepsia, nausea.
Potentially Fatal: Intermittent claudication and skin ulcer.

MONITORING PARAMETERS:
Blood pressure, electrolytes, serum creatinine, BUN.
CONTRAINDICATIONS:
Known hypersensitivity(eg, anaphylaxis, angioedema) to telmisartan or any component of the formulation: concurrent use of aliskiren in patients with diabetes and moderate-to-severe renal impairment(GFR<60 mL/min/1.73 m2); Pregnancy; breast-feeding; fructose intolerance.
DRUG-DRUG INTERACTIONS:
May increase plasma levels of digoxin. May increase serum lithium levels and toxicity. May reduce plasma levels of warfarin. Increased risk of hypokalemia with K-sparing diuretics, K supplements or K-containing salt substitutes. May antagonize hypotensive effect and increase risk of renal impairment with NSAIDs.
Potentially Fatal: May increase nephrotoxic, hyperkalemia and hypotensive effect with aliskiren in patients with diabetes and renal impairment (GFR<60Ml/min).
ACEI's, Alfuzosin, Amifostine, Amphetamines, Barbiturates, Cardiac Glycosides, Cyclosporine, Diazoxide, Drospirenone, Heparin, Lithium, Nicorandil, Nitroprusside, NSAID's, Potassium-Sparing Diuretics, Sodium Phosphate.
STORAGE:
Oral: Store at 25˚C
PREGNANCY CATEGORY[USFDA]:
Category D: There is positive evidence of human foetal risk, but the benefits from use in pregnant women may be acceptable despite the risk(e.g., if the drug is neede in a life-threatening situation or for a serious disease for which safer drugs cannot be used or are ineffective).

**ANGIOTENSIN CONVERTING ENZYME INHIBITORS**

Angiotensin converting enzyme inhibitors (ACE inhibitors) are medications that slow (inhibit) the activity of the enzyme ACE, which decreases the production of Angiotensin II. As a result, blood vessels enlarge or dilate, and blood pressure is reduced. This lower blood pressure makes it easier for the heart to pump

blood and can improve function of a failing heart. In addition, the progression of kidney disease due to high blood pressure or diabetes is slowed.

**RAMIPRIL**

Ramipril is an ACE inhibitor. It is used to treat high blood pressure (hypertension) or congestive heart failure, and to improve survival after a heart attack.

PHARMACOLOGICAL CLASS:

Ramipril belongs to the class ACE inhibitors Direct Renin Inhibitors.

AVAILABLE DOSES AND INDICATION:

Oral: Hypertension

Adult: Initially, 2.5mg once daily, 1st dose preferably given at bedtime. Maintenance: 2.5-5mg/day as a single dose, up to 10mg/day as needed.

Oral: Heart Failure

Adult: Initially, 1.25mg once daily, Maximum: 10mg daily. Doses ≥ 2.5mg may be given in 2 divided doses

Oral: Post Myocardial Infarction

Adult: Initially, 2.5mg twice daily, may increase to 5 mg twice daily after 2 days. Start treatment: 3-10 days after infarction. Maintenance: 2.5-5mg twice daily.

Oral: Prophylaxis of cardiovascular events in high risk patients

Adult: Initially 2.5mg once daily, may increase to 5mg once daily after 1 week if tolerated. Maintenance: 10mg once daily after a further 3 wk.

MECHANISM OF ACTION

Ramipril, a prodrug of ramiprilat, competitively inhibits ACE from converting Angiotensin I to Angiotensin II (a potent vasoconstrictor) resulting in increased plasma renin activity and reduced aldosterone (a hormone that causes water and Na retention) secretion. This promotes vasodilation thus producing a hypotensive effect and a beneficial effect in CHF.

PHARMACOKINETICS

Absorption: Well absorbed from GI tract (50-60%). Bioavailability: 28% (Ramipril); 44% (ramiprilat). Time to peak plasma concentration: 2-4 hour (ramiprilat).

Distribution: Plasma protein binding: Approx. 56% (ramiprilat); 73% (ramipril).

Metabolism: undergoes enzymatic saponification by esterases to form ramiprilat (active metabolite)

Excretion: mainly via urine (60%, as ramiprilat); faeces (approx. 40%). Elimination half life: 13-17 hour.

Onset: 1-2 hour

Duration: 24 hour

ADVERSE DRUG REACTIONS

Laryngeal stridor, angioedema of the face and tongue, glottis, intestinal angioedema, cholestatic jaundice, asthenia/fatigue, headache, dizziness, hypotension, persistent and non-prosuctive cough, syncope, nausea, vomiting, vertigo, abnormal kidney function, and diarrhea, hyperkalemia, anemia, neutropenia/agranulocytosis, pancytopenia, thrombocytopenia, increased BUN and serum creatinine levels.

Potentially fatal: Severe anaphylactic reactions and angioedema. Rarely, hepatic necrosis.

MONITORING PARAMETERS

Monitor BP, serum creatinine and potassium levels. Monitor renal function during the 1st few weeks of treatment and periodically thereafter.

CONTRAINDICATIONS

History of angioedema (hereditary, idiopathic or due to previous angioedema with ACE inhibitors). Concomitant use with aliskiren in patients with diabetes or renal impairment, pregnancy and lactation.

DRUG DRUG INTERACTIONS

May enhance hypotensive effect with diuretics and other antihypertensives. May increase risk of renal function deterioration with NSAID's. may increase serum levels and toxicity of lithium. May increase hyperkalemia effect with K-sparing diuretics and supplements.

Potentially fatal: Concomitant use with aliskiren may increase the risk of hyperkalemia, hypotension and nephrotoxicity in patients with diabetes or renal impairment.

STORAGE

Oral: Store between 15-30˚C.

PREGNANCY CATEGORY [USFDA]

Category D: There is positive evidence of human fetal risk, but the benefits from use in pregnant women may be acceptable despite the risk (e.g., if the drug is needed in a life threatening situation or for a serious disease for which safer drugs cannot be used or are ineffective).

**CALCIUM CHANNEL BLOCKERS**

Calcium channel blockers are widely used in the treatment of hypertension, angina pectoris, cardiac arrhythmias and other disorders. The longer-acting preparations have been prescribed with increasing frequency. Calcium channel blockers inhibit the L-type calcium channel on cells, there are divided into two major categories based upon the predominant physiologic effects: the dihydropyridines, which are predominantly vasodilators and generally have chronotropic and ionotropic effects, and the non-dihydropyridines, which are less potent vasodilators and also slow cardiac contractility and conduction.

**AMLODIPINE**

Amlodipine is a long-acting calcium channel blocker belonging to the DHP or Dihydropyridines class. It is used as an antihypertensive and in the treatment of stable angina. Like other calcium channel blockers, amlodipine acts by relaxing the smooth muscle in the arterial and arteriolar wall, decreasing Total peripheral resistance thus reducing BP.

PHARMACOLOGICAL CLASS

Amlodipine belongs to the class of dihydropyridines derivative selective calcium channel blockers with mainly vascular effects. Used in the treatment of cardiovascular diseases.

AVAILABLE DOSES AND INIDCATION

Oral: Prinzmetal's Angina; Stable Angina

Adult: Initially, 5mg once daily increased to 10mg once daily if necessary.

Elderly: initially, 2.5mg once daily.

Hepatic Impairment: initially, 2.5mg once daily.

Oral: Hypertension

Adult: Initially, 5mg once daily increased to 10mg once daily if necessary.

Child: 6-17 yrs: Initially, 2.5mg once daily, increased to 5mg once daily if necessary.

Elderly: Initially, 2.5mg once daily.

Hepatic Impairment: Initially, 2.5mg once daily.

MECHANISM OF ACTION

Amlodipine relaxes peripheral and coronary vascular smooth muscle. It produces coronary vasodilation by inhibiting the entry of Ca iona into the slow channels or select voltage-sensitive channels of the vascular smooth muscle and myocardium during depolarization. It also increases myocardial oxygen delivery in patients with vasospastic angina.

PHARMACOKINETICS

Absorption: Well absorbed from the GI tract. Bioavailability: Approx. 60-63%. Time to peak plasma concentration: 6-12 hr.

Distribution: Volume of distribution: 21 L/kg. Plasma protein binding: Approx. 98%.

Metabolism: Hepatically metabolized to inactive metabolites.

Excretion: Via urine (mainly as metabolites, < 10% as unchanged drug). Terminal elimination half life: 35-50 hr.

ADVERSE DRUG REACTION

Somnolence, dizziness, headache, ankle swelling, edema, flushing, palpitations, fatigue, abdominal pain, nausea. Rarely, confusion, rash, gingival hyperplasia, muscle cramps, dyspnoea.

MONITORING PARAMETERS

Monitor BP and heart rate.

CONTRAINDICATIONS

Severe hypotension, shock (including Cardiogenic shock), obstruction of the outflow tract of the left ventricle (e.g., aortic stenosis), haemodynamically unstable heart failure after acute MI.

DRUG-DRUG INTERACTIONS

Plasma concentrations may be elevated with CYP3A4 inhibitors (e.g., azole, antifungals, ritonavir). Concomitant therapy with simvastatin may increase risk of myopathy including rhabdomyolosis. May increase cyclosporine plasma levels and conivaptan.

STORAGE

Oral: Store between 15-30˚C.

PREGNANCY CATEGORY [USFDA]

Category C: Either studies in animals have revealed adverse effects on the foetus (teratogenic or embryocidal or other) and there are no controlled studies in women or studies in women and animals are not available. Drugs should be given only if the potential benefit justifies the potential risk to the foetus.

**BETA BLOCKERS**

Beta blockers or beta-adrenergic blocking agents are a class of drugs used for various indications like the management of cardiac arrhythmias, cardioprotection after MI and HTN. Beta blockers block the action of endogenous catecholamines (adrenaline and nonadrenaline) on beta adrenergic receptors.

Three types of beta receptors are known, designated $\beta_1$, $\beta_2$ and $\beta_3$ receptors. Beta 1 receptors are located mainly in the heart and in the kidneys. Beta 2 receptors are located mainly in the lungs, gastrointestinal tract, liver, uterus, vascular smooth muscle, and skeletal muscle. Beta 3 receptors are located in fat cells.

**PROPRANOLOL**

Propranolol is a cardioselective beta-blocker that is widely used in the treatment of hypertension and angina pectoris.

PHARMACOLOGICAL CLASS

Propranolol belongs to the class of selective beta-blocking agents. Used in the treatment of cardiovascular disease.

AVAILABLE DOSES AND INCICATION

Oral: Hypertension

Adult: 25-100mg once daily. Takes 1-2 week for full effect to be observed.

Oral: Angina Pectoris

Adult: 50-100mg/day given as single or in divided doses. Max: 200mg/day

Intravenous: Emergency treatment of cardiac arrhythmias

Adult: 2.5mg injected at a rate of 1mg/min, may repeat every 5 min if needed. Max: 10mg. Alternatively, 0.15mg/kg to be infused over 20 min. May repeat inj or infusion procedure every 12 hr as needed. Once control is achieved, maintain with oral doses of 50-100mg/day.

MECHANISM OF ACTION

Propranolol is a competitive cardio selective $\beta_1$-blocker and does not have effect on $\beta_2$-receptors except in high doses. It reduces resting and exercise-induced heart rate as well as myocardial contractility.

PHARMACOKINETICS

Absorption: Rapidly but incompletely absorbed from the GI tract (approx. 50%). Time to peak plasma concentration: 2-4 hr (oral).

Distribution: Enters breast milk, crosses the placenta and blood-brain barrier (small amounts). Plasma protein binding: 6-16%.

Metabolism: Undergoes minimal hepatic metabolism.

Excretion: Via urine (40% as unchanged drug); faeces (50%). Plasma half life: Approx. 6-7 hr.

Onset: 2-4 hour (oral)

Duration: 12-24 hr

ADVERSE DRUG REACTIONS

Bradycardia, hypotension, chest pain, edema, heart failure, dizziness, sweating, fatigue, insomnia, lethargy, confusion, mental impairment, depression, headache, nightmares, constipation, diarrhea, nausea, impotence, cold extremities.

MONITORING PARAMETERS

Monitor ECG, heart rate and BP.

CONTRAINDICATIONS

Sick sinus syndrome, severe Bradycardia, $2^{nd}$ or $3^{rd}$ degree AV block, uncompensated cardiac failure, severe asthma or COPD, Cardiogenic shock, untreated pheochromocytoma, metabolic acidosis, severe peripheral circulatory disease.

DRUG-DRUG INTERACTIONS

Concomitant administration with reserpine may increase hypotension and Bradycardia. Additive with Calcium channel blockers, hydralazine, methyldopa. Increased risk of Bradycardia and heart block with veramapil and diltazem. May decrease hypotensive effects with NSAID's (e.g indometacin). Enhanced bradycardic effect with disopyramide, amiodarone or digitalis glycosides. May exacerbate rebound HTN upon discontinuance of clonidine treatment.

STORAGE

Intravenous: Store between 20-25˚C.

Oral: Store between 20-25˚C.

PREGNANCY CATERGORY [USFDA]

Category D: There is positive evidence of human foetal risk, but the benefits from use in pregnant women be acceptable despite the risk (e.g., if the drug is needed in a life-threatening situation or for a serious disease for which safer drugs cannot be used or are ineffective).

**DIURETICS**

Diuretics are used to treat heart failure, liver cirrhosis, hypertension, influenza, water poisoning and certain kidney diseases. A diuretic is any substance that promotes diuresis, the increased production of urine. All diuretics increase the excretion of water from bodies, although each class does so in a distinct way.

Types of diuretics are loop ceiling/high ceiling diuretics, thiazides, carbonic anhydrous inhibitors, potassium sparing diuretics, calcium sparing diuretics, osmotic diuretics, low diuretics.

**HIGH CEILING/LOOP DIURETICS**

High ceiling diuretics may cause a substantial diuresis – up to 20%. Loop diuretics, such as Furosemide, inhibit the body's ability to reabsorb sodium at the ascending loop in the Nephron, which leads to an excretion of water in the urine, whereas water normally follows sodium back into the extracellular fluid.

**FUROSEMIDE**

Furosemide used to treat fluid build-up due to heart failure, liver scarring, or kidney disease. It may also be used for the treatment of high blood pressure (hypertension).

PHARMACOLOGICAL CLASS

Furosemide is a type of loop diuretic that works by decreasing the reabsorption of sodium by the kidneys. It is also used in prevention of exercise-induced pulmonary hemorrhage.

AVAILABLE DOSES AND INDICATIONS

Oral: Hypertension

Adult: Solution: 8mg/mL, 10mg/mL Tablet: 20mg, 40mg and 80mg.

Child: Solution: 8mg/mL, 10mg/mL Tablet: 20mg, 40mg and 80mg.

Elderly: Oral solution, lower initial doses are recommended, 10mg/mL

Edema:Adults: 20mg to 80mg PO daily in morning, with interval of 6-8 hrs, dose adjusted upto, 600mg daily. 20-40mg IM/IV increased by 20mg every 2 hours until response is achieved. It is given slowly over 1-2 min.

Infants and Children: 2mg/kg daily per oral., increased by 1 to 2mg/kg in 6 to 8 hours carefully adjusted not to exceed 6mg/kg daily.

MECHANISM OF ACTION

It inhibits sodium and chloride reabsorption in the proximal part of the ascending loop of henle, promoting the excretion of sodium, water, chloride and potassium. This drug may result in temporary increase in glomerular filtration rate and a decrease in peripheral vascular resistance.

PHARMACOKINETICS

Absorption: 60% of dose is absorbed from the GI tract after oral administration. Time to peak plasma concentration: 20-60 minutes.

Distribution: plasma protein binding: 95%. Crosses the placental barrier and appears in breast milk.

Metabolism: Metabolized minimally by the liver.

Excretion: 50-80% via urine; plasma half life is 30 minutes.

Duration: 6-8 hours after oral administration and 2 hours after I.V administration.

ADVERSE DRUG REACTIONS

Vertigo, headache, dizziness, paresthesia, restlessness, fever, volume depletion, dehydration, orthostatic hypotension, blurred vision, abdominal discomfort, pain, diarrhea, anorexia, nausea, vomiting, constipation, pancreatitis, polyuria, frequent urination, leucopenia, muscle spasm, weakness,

CONTRAINDICATIONS

Contraindicated in patients hypersensitive to drug and patients with anuria, hepatic coma, or severe electrolyte depletion. Contraindicated if increased azotemia, oliguria.

MONITORING PARAMETERS

Monitor for dehydration.

DRUG-DRUG INTEARCTIONS

Concomitant administration with sucralfate may reduce diuretic and antihypertensive effect. Administration with salicylates may cause salicylate toxicity. Administration with NSAID's may inhibit diuretic response. Administration with anti diabetics decreases hypoglycemic effects. Administration with aminoglycoside antibiotics, cisplatin may potentiate ototoxicity. Administration with amphotericin B, corticosteroids, metalazone increases risk of hypokalemia.

STORAGE

Oral: Store at room temperature away from light and moisture. Do not freeze.

PREGNANCY CATEGORY [USFDA]

Category C: Treatment during pregnancy necessitates monitoring of fetal growth because of risk for higher fetal birth weights.

**SPIRONOLACTONE**

Spironolactone is used to treat high blood pressure (hypertension) and heart failure. Lowering high blood pressure helps prevent strokes, heart attacks, and kidney problems. It is also used in the management of edema, treatment of diuretic-induced hypokalemia. It is also helps in the diagnosis of primary hyperaldosteronism.

PHARMACOLOGICAL CLASS

Spironolactone belongs to the class potassium-sparing diuretic.

AVAILABLE DOSES AND INDICATIONS

Tablets: 25mg

Tablets (film-coated): 25mg, 50mg, 100mg

Oral: Hypertension

Adult: 50-100mg daily in divided doses.

Children: Initially, 3.3mg/kg or 60mg/$m^2$ daily in divided doses

Oral: Edema

Adult: 25-200mg daily in divided doses

MECHANISM OF ACTION

The mechanism of action of Spironolactone is unknown. Spironolactone may block the effect of aldosterone on arteriolar smooth muscle. Spironolactone competitively inhibits aldosterone effects on the distal renal tubules, increasing sodium and water excretion and decreasing potassium excretion.

PHARMACOKINETICS

Absorption: 90% is absorbed after oral administration.

Distribution: Plasma protein binding: drug and its metabolite canrenone, are more than 90% bound.

Metabolism: Rapidly and extensively metabolized to canrenone.

Excretion: Canrenone and other metabolites are excreted primarily in urine, and a small amount is excreted in faeces via the biliary tract; Elimination half life: 13-24 hrs (canrenone); 1-2 hrs (spironolactone)

ADVERSE DRUG REACTIONS

Headache, drowsiness, lethargy, confusion, ataxia, diarrhea, gastric bleeding, ulcers, gastritis, vomiting, hyperkalemia, dehydration, metabolic acidosis, urticaria, drug fever, breast soreness in women, agranulocytosis, menstrual disturbances in women.

DRUG-DRUG INTERACTIONS

Concomitant administration with ACE inhibitors, potassium supplements, potassium-containing drugs such as parental penicillin may increase the risk of hyperkalemia. With anesthetics, norepinephrine reduces the response of these drugs. With aspirin it may slightly decreases response to spironolactone. With cardiac glycosides it increases serum digoxin levels and subsequent toxicity. With NSAID's like ibuprofen or indomethacin may impair renal function, thus affecting potassium excretion.

MONITORING PARAMETERS

Monitor BP, serum electrolytes, uric acid, glucose, renal function, volume status.

STORAGE

Oral: keep in a cool, dry place where the temperature stays below 30˚C

PREGNANCY CATEGORY [USFDA]

Category C: Limited available data did not demonstrate an association of major malformations or other adverse pregnancy outcomes with spironolactone. Risks may occur to the mother and fetus associated with heart failure, cirrhosis.

## III. Literature Review

**1. Mohammed Altaf et al, 2014 study found that "Drug utilisation evaluation of antihypertensives in geriatric patients in a tertiary care hospital"**

A single centre prospective observational study was carried out for a period a three months in an out-patient department of Owaisi Hospital and Research Centre.

The most common drug classes involved in the study was Calcium Channel Blockers 37% followed by Angiotensin II Receptor Antagonists 21% and the most commonly prescribed drugs in the study population were Amlodipine 37% Losartan 11% and Telmisartan 10%. The most common anti-hypertensive fixed dose combination therapy involved in the study was Telmisartan + Hydrochlorothiazide 15% and most common two drug combination therapy involved in the study was Amlodipine + Atenolol 7% followed by Metoprolol + Amlodipine 1%. Our study shows that the most commonly prescribed drug classes involved were Calcium Channel Blockers followed by Angiotensin II Receptor Antagonists and the anti-hypertensive drug combinations among hypertensive patients were considerable and this practice positively impacted on the overall blood pressure control.

**2. Ajmal mankadavath et al, 2014 study found that "A prospective drug use evaluation of anti hypertensive drugs in in-patients of a tertiary referral care hospital"**

Hypertension is a chronic illness associated with high morbidity and mortality. Once hypertension is diagnosed, starting anti hypertensive therapy on a long-term basis along with regular follow up is important. The study was conducted at the General Medicine and Cardiology Department involving the in-patients. The majority of the patients were females with 56% whereas the males comprised 44%, with most of the patients suffering from stage II hypertension. The study revealed that a high proportion of the hypertensive patients had co-morbid diabetes mellitus. The most commonly prescribed class of anti hypertensive drugs was Angiotensin Receptor Blockers, followed by Calcium Channel Blockers and β-Blockers. With regard to patient therapy, 32.0% received monotherapy, where as 68.0% received combination therapy, 16% of which received FDCs.
Conclusions: The study shows that clinical pharmacists can play a key role in promoting rational prescription and improving adherence to medication.

**3. Georgy M. Varghese et al, 2016 study found that " Study on drug utilization patterns of antihypertensive agents in a tertiary care hospital"**

A prospective study was carried out for duration of 6 months. 118 cases were included based on inclusion and exclusion criteria, to assess the utilization of antihypertensive agents in a tertiary care hospital. In the study, 118 cases involving patients undergoing antihypertensive therapy were encountered. Most of the patients were between 51-60 years (40.17%) and 61-70 years (35.04%). The most utilized antihypertensive in all case study were Calcium Channel Blockers which were utilized in 50.84% of total cases, Angiotensin Receptor Blockers 35.59%, Diuretics 27.96% and Beta Blockers 18.64%. These are all first line drugs for hypertension treatment. In combination therapy, combination of Calcium Channel Blocker + Angiotensin Receptor Blocker was the most utilized among two drug combinations (11.86% of total cases), whereas in three drug combinations, Calcium Channel Blocker + Angiotensin Receptor Blocker + Diuretics (7.62%).

**4. Supratim Datta, 2016 study found that "Utilization study of antihypertensives in South Indian Tertiary Care Teaching Hospital and adherence Standard Treatment Guidelines"**

Hypertension represents a major health problem primarily because of its role in contributing to the initiation and progression of major cardiovascular diseases. This cross-sectional observational study aims at analyzing the utilization pattern of antihypertensives used for the treatment of hypertension at a tertiary care hospital in perspective of standard treatment guidelines. Medical records of the patients were scrutinized after which 286 prescriptions of patients suffering from hypertension were included. The collected data were sorted and analyzed on the basis of demographic characteristics and co-morbidites.the Calcium Channel Blockers were the most frequently used antihypertensive class of drugs (72.3%). Amlodipine (55.6%) was the single most frequently prescribed antihypertensive agent. The utilization of Thiazide Diuretics was 9%. The treatment pattern, in general conformed to standard treatment guidelines. Few areas, however, need to be addressed such as the underutilization of Thiazide Diuretics need for more awareness of drugs from the NLEMs and enhanced use of ACE-I/ARB in diabetic hypertensives.

**5. D. Bhavika et al, 2016 study found that "Drug utilization study of antihypertensives in a tertiary care hospital"**

Hypertension is a major non-communicable disease and a risk factor for cardiovascular diseases. A prospective cross sectional observational study was carried out in the out-patient of General Medicine department of Osmania General Hospital. The prescriptions of the hypertensive patients visiting the out-patient were monitored. From the data collected, the prescription patterns of antihypertensive drugs, and WHO prescription indicators, were analyzed out of the 301 study subjects, 134 (44.51%) were males and 167 (550.48%) were females, with the maximum number of patients (197) falling in the age group 51-70 years. Among the antihypertensive drugs prescribed, Amlodipine was most frequently prescribed (53.15%). The frequently used drugs for monotherapy- Amlodipine (26.91%) and for two drug therapy – Amlodipine + Enalapril (17.27%), for three drug therapy – Atenolol + Enalapril + Nifedipine (2.32%). The WHO prescribing indicators as analyzed from the data collected are; Average number of drugs prescribed per encounter – 5.64%/prescription, Percentage of medicines prescribed by generic name – 89.22%, Percentage of medicines prescribed from essential drug list – 90.17%.

**6. Krunal C Solanki et al, 2013 study found that "Drug utilization study of antihypertensive drugs and their adverse effects in patients of a tertiary care hospital"**

A prospective, observational study was conducted by Department of Pharmacology in a tertiary care teaching hospital over a period of 6 months. The diagnosis and line of treatment to be given was decided by the physician incharge of the Department of Medicine. All the information of ADR was recorded in CDSCO

suspected ADR reporting form. Enalapril was the most commonly prescribed antihypertensive drug (79.66%). 95 patients (15.83%) from the total of 600 patients developed ADR. Most common ADR was cough (18.94%) followed by headache (12.63%) and vomiting (10.52%). Enalapril was responsible for about half of the ADR (50.52%) followed by Amlodipine (25.26%) and Furosemide (25.26%). Rational utilization pattern of antihypertensive drugs was observed. However, Diuretics and Calcium Channel Blockers were prescribed less commonly. Most of the ADRs were probable (55.79%) and mild (30.53%).

**7. Amit Sharma et al, 2017 study found that "Drug utilization study on oral hypertensive medication patients and assessment of medication adherence to JNC – 8 guidelines in North Indian tertiary care hospital: A cross-sectional study"**

Hypertension is a common disease which is also known as elevated blood pressure above the normal, i.e., systolic blood pressure above 130 mmHg and diastolic blood pressure above 90 mmHg. A drug utilization review on hypertensive drugs was commenced to determine and evaluate the different classes of antihypertensive medications with respect to diagnosis and ADRs. Study was commenced in Guru Gobind Singh Medical College and Hospital, Faridkot. Study was conducted for a period of 6 months commencing from October, 2015 to March, 2016 as per inclusion exclusion criteria. Among the hypertensive class, it was found that Diuretics were most prescribed drug followed by CCB's, ACE Inhibitors, β Blockers, α-β adrenergic antagonists and Angiotensin II Receptor Antagonists.

**8. Quiping Gu et al, 2010 study found that "Trends in antihypertensive medication used and blood pressure control among United States Adults with Hypertension"**

The monitoring of national trends in hypertension frequent and control can provide important insight into the effectiveness of primary prevention efforts for cardiovascular disease. The objective of this study was to examine recent trends in antihypertensive medication use and its impact on blood pressure control among US adults with hypertension. Overall, the use of thiazide diuretics, β-blockers, Angiotensin-converting enzyme inhibitors, and Angiotensin receptor blockers increased by 23%, 57%, 31%, and 100% respectively. In comparision with monotherapy, single-pill combinations and multiple-pill combinations were associated with 55% and 26% increased likelihoods of blood pressure control, respectively. By the 2009 to 2010 time period, 47% of all hypertensive people and 60% of treated hypertensive people had blood pressure controlled. However, higher treated but uncontrolled hypertension rates continued to persist among older Americans, non-Hispanic blacks, diabetic people, and those with Chronic Kidney Disease. Also, Mexican Americans with hypertension were still less likely to take antihypertensive medication that non-Hispanic whites with hypertension.

**9. Zahra eslampanah, 2017 study found that "Drug utilization evaluation of anti-hypertensive agents in a medical care hospital"**

The study was simple prospective observational study which was carried out for a period of six months. In the study period, 200 hypertensive cases were collected. Of these, 134(67%) were males and 66(33%) were females who underwent anti-hypertensive therapy. Among the various anti-hypertensive drugs, only 6 major classes were used in the study sample. They were Diuretics(Ds), Calcium Channel blockers(CCBs), Angiotensin Receptor Blockers(ARBs), Beta Adrenergic Blockers(BABs), Alpha Adrenergic Blockers(AABs) and Angiotensin Converting Enzyme Inhibitors(ACEIs).

Diuretics were used the highest in 112(40.14%0 prescriptions and AABs in 7(2.50%) prescriptions being the least. Among diuretics, Furosemide was the most frequently utilized anti-hypertensive drug(30.95%) and Ramipril was the least utilized drug(1.36%). Evaluation of utilization of anti-hypertensive agents and implementation of effective strategies can greatly aid in improving the quality use of anti-hypertensive agents.

**10. Jay shah et al, 2013 study found that "Study of utilization pattern of antihypertensive drugs in hypertensive diabetic patients with or without reduced renal function at tertiary care teaching hospital"**

The pattern of use of antihypertensive drugs in 50 hypertensive-diabetic patients was evaluated in correlation with its renal function and BP control achieved was compared in patients with and without reduced renal function. Total 63 antihypertensive medication episodes were prescribed for 50 patients. Out of which 76% patients were receiving 1 drug, 22% receiving 2 drugs and 2% receiving 3 drugs of different antihypertensive class. Most patients were receiving Angiotensin Converting Enzyme Inhibitors (ACE I)/ Angiotensin Receptor Blockers (ARBs) (60%), followed by CCBs (24%), Beta-blockers (20%), and Diuretics (16%). Patients on monotherapy were mostly receiving ACE I/ ARB (65.78%). Beta-blockers were more commonly prescribed in patients with reduced renal function (p=0.005). BP control was achieved in 63.15% patients in monotherapy and 33.33% in polytherapy group.

**11. V. Jyothirmayee et al, 2017 study found that "Drug utilisation evaluation of antihypertensive drugs in chronic kidney disease patients"**

Retrospective observational study was conducted in in-patient Nephrology Department of B.B.R. Hospital from Sep 2016 to Feb 2017 and 155 case records of patients diagnosed with CKD and HTN, above 18 years of age, belonging to both genders were collected. The prevalence of CKD is more in male than in female and most commonly age group of > 60 yr was affected with CKD. Diuretics were most commonly prescribed drugs. The preferable drugs given among antihypertensive were diuretics, calcium channel blockers, beta-blockers, alpha-blockers, ARBs. Most of the CKD patients were male (63.87%) in distribution. Of the 155 cases, 69.03% patients were also suffering from diabetes. Majority of patients (both diabetic and non diabetic hypertensive patients with CKD) were prescribed with Diuretics (40.71%) of which Furosemide (31.12%) was predominantly seen. 65% of prescribed drugs were brand name drugs. Polypharmacy was observed in most of the prescriptions.

**12. Gupta dharmender et al, 2018 study found that "Pattern of drug utilization of antihypertensive drugs in a tertiary care teaching hospital in eastern Uttar Pradesh"**

Overall 68.5% patients were on monotherapy while rest of the 31.5% on combination therapy. Calcium Channel Blockers (CCBs) 39.4% were the most commonly prescribed antihypertensive agent as monotherapy. In the present study, it was found that CCBs were the most commonly prescribed antihypertensive drug, followed by ARBs in monotherapy. Combination therapy was given according to associated risk factors and comorbid conditions.

**13. Navya Kalukoori et al, 2018 study found that "Drug utilization review of hypertension therapy as per JNC VII guidelines in a south India tertiary care hospital"**

Drug utilization rates in all study subjects till date stands at Diuretics (30.62%), Angiotensin Receptor Blockers (27.82%), β-blockers (11.7%), Calcium Channel Blockers (13.5%), ACE Inhibitors (16.07%). The most frequently prescribed antihypertensive drugs were Diuretics followed by ARBs, ACE Inhibitors, Beta Blockers and CCBs. As for individual medicines, Hydrochlorothiazide were the most commonly prescribed antihypertensive drugs followed by Telmisartan, Amlodipine, Atenolol, Ramipril, Torsamide, Losartan and 69.6% received monotherapy and 30.4% received combination therapy (including fixed drug combinations). The prescription pattern was found to be in accordance with JNC VII guidelines.

**14. Bathula et al, 2015 study found that "A prospective study on prescribing pattern and utilization of antihypertensive drugs in a Tertiary care teaching hospital"**

A prospective observational study was conducted for a period of 3 months from March 2015 to May 2015 in medicine department of Viswabarathi Hospital, Kurnool, AP. A total of 125 prescriptions were analysed. 60 (48%) were male patients and 65 (52%) were female. Maximum hypertensives were seen in the age group of 30-39 and 20-29 prospectively. Our result has shown that there was increased usage of calcium channel blockers (46.4%), diuretics (41.6%), and Angiotensin receptor blockers (39.2%) followed by beta blockers (17.6%). The present study showed that calcium channel blockers are the most prescribed ones in hypertension. Also it was found that combination therapy is frequently prescribed rather than monotherapy.

**15. Sai Sujana Supraneni et al, 2015 study found that "An assessment of antihypertensives Drug utilization patterns and adherence to JNC-7 guidelines in South Indian tertiary care teaching hospital "**

A total of 200 hypertension prescriptions were collected in a prospective observational study from February 2014 to July 2014. The average age was 58.8 ± 2.40 years (males) and 53.7 ± 2.3 years (females). Stage 1 hypertension (36% males, 35.2% females) was most predominant than stage 2 hypertension (29.33% males, 30.4% females) and hypertension emergency (25.33%, males; 23.2%, females). Diabetes mellitus (19%, males; 45%, females) and cardiovascular diseases (27%, males; 36%, females) are the most common co-morbidities in hypertension patients followed by renal diseases.

**16. V. Gowri et al, 2015 study found that "Drug utilization patterns of antihypertensives in various wards in a tertiary care hospital in Tamil Nadu"**

In this prescription survey, calcium channel blockers were most commonly prescribed drug in monotherapy as well as combination therapy. Beta blockers were most commonly used in patients with hypertension associated cardiovascular disease. Angiotensin converting enzyme inhibitors, Angiotensin receptor blockers were most commonly used in concomitant diseases like, diabetes mellitus and hyperlipidemia.

**17. Kalpana bharani et al, 2018 study found that "Drug utilization pattern of antihypertensive drugs in chronic kidney disease stage 5 patients in a tertiary care hospital of central India"**

Of 198 patients, 63 (31.8%) were females and 135 (68.2%) were males, showing male preponderance. Majority of the patients (54%) belonged to the each group 41-60 years. Majority of the patients were having diabetic nephropathy (40.9%), found by CGN-CKD 5d (18.7%) and CIN-CKD 5d (17.2%). 11.6% patients were on dialysis, while 88.4% were on dialysis with a mean relation of dialysis of 35.45 ± 34.57 months. Calcium channel blockers were given in 87.4% patients, followed by centrally acting drugs in 56.1% patients, beta blockers in 51.0% and alpha blockers in 39.9%. 93.9% patients were on multidrug antihypertensive therapy.

**18. Pavitra R Y 1 et al, 2014 study found that "Drug utilization pattern of antihypertensive drugs in chronic kidney disease patients in a tertiary care hospital"**

In diabetic patients with hypertension, 66.6% were two drug combinations, clinidipine and torsemide (52%), amlodipine and Furosemide (28%), metroprolol and clinidipine (11%). 30% with three drug combinations, Non diabetic patients with hypertension, 55% had three drug combinations, Metoprolol, Furosemide, Prazosin (45%), Clinidipine, Torsemide, Prazosin (33%) and 45% two drug combinations, Amlodipine, Furosemide (46%) and Metoprolol, Torsemide (33%) were commonly used. Combination of diuretic and calcium channel blocker (80%) was commonly used in hypertensive patients with diabetic. Use of antihypertensive drugs such as selective beta blocker, alpha-blocker, calcium channel blocker combination (45%) more commonly used in non diabetic with hypertension.

**19. Safila Naveeb et al, study found that "Use of antihypertensive drugs in patients with diabetes"**

Out of 200 patients, 131 (65.5%) were with hypertension and 66 (33%) consisted of diabetes and hypertension and 3 patients (2%) were with hypertension along with any other disease. Most of the patients received ACEI (Angiotensin Converting Enzyme Inhibitor) 40.29% followed by CCB (Calcium Channel Blockers) 18.90%, B-blockers (Beta Blockers) 17.90%, Diuretics 11.44%, ARBs (Angiotensin Receptor Blockers) 7.96% and then Alpha blockers 1.49%. the pattern of use og antihypertensive drugs in patients with hypertension along with diabetes comprised of ACEI being the highest i.e., 47.40%, then CCBs 14.81%, Diuretics 12.59%, ARBs and Beta blockers both 11.85% and least prescribed Alpha blockers 1.48%.

**20. Mahalakshmi Mohan et al, study found that "Drug utilization evaluation of antihypertensives in a super specialty hospital"**

The main outcomes of the study were: i) Amlodipine was reported most effective in both cases of monotherapy and combined therapy of antihypertensive patients. The DDD/100 bed day's value for Amlodipine was found to be 32.55. ii) Treatment rates depend on age: Young hypertensive patient compared with the older age groups were less aggressively treated (with low rate of drug treatment mostly with monotherapy). iii) Treatment intensity increased where concomitant diseases were present, while there were only minor changes in preferences of various drug classes.

## IV. Aims And Objectives

**AIM:**

To evaluate the use of antihypertensives in patients having hypertension in the general medicine department of a tertiary care hospital.

**OBJECTIVES**:

- To study the drug utilization review of antihypertensives.
- To assess the drug prescribing patterns of antihypertensives.
- To study profile of patients with hypertension.
- To study the demographics (age, gender).
- To study the clinical presentations and co-morbid illness.
- To find the most commonly used prescribed antihypertensive drugs.

**PLAN OF WORK**

- All the hypertensive patients with the use of antihypertensive drugs data will be collected based on their age, gender, risk factors, comorbidity condition.
- Patients who meet the above study criteria are enrolled into the study.
- All necessary information is collected from various sources.

Patients: Data that can be collected includes demographic details (Age, gender, address), weight, height, chief complaints, social history, family history, past medical history, past medication history and patient complications.

PATIENT CASE SHEET: General examination, vital signs, lab data(CBP, CUE, Serum electrolytes, thyroid profile).

- Current medication and final diagnosis.
- Lab parameters.
- The above data will be documented in the data collection form.
- By collecting the above data, the highly prescribed antihypertensive drugs will be assessed.


## V. Methodology

**STUDY SITE**: MediCiti Institute of Medical Sciences and Hospital

This study was carried out at MediCiti Institute of Medical Sciences. This centre was established with an aim to provide cost effective medical services to the people of Hyderabad and surrounding areas.

**STUDY DESIGN**: Cross sectional Prospective Observational study

**STUDY DURATION**: six months

**SAMPLE SIZE**: The sample size of the study is 300

**SCREENING OF PATIENTS**:

- Patients visiting the general medicine department of the tertiary care centre will be screened clinically and diagnostically
- Clinical examination
- Past medication history
- Comorbid condition

**STUDY CRIETERIA**

INCLUSION CRITERIA

- All patients with age group of 26-85 yrs and above.
- Patients of both genders.
- Patients of severe concurrent diseases (cardio respiratory, renal, hepatic, neurological disorders).
- Patients on prescribed medicines and over the counter medicines for at least 6 months.
- Patients willing to cooperate and volunteering to give verbal communication.

EXCLUSION CRITERIA

- Patients not suffering from hypertension
- Patients not expected to cooperate or unconscious and comply with the treatment.

**STUDY CONDUCT**

- Study was conducted in MediCiti Institute of Medical Sciences and Hospital.
- Study was cross sectional prospective observational study in which patients with Hypertension, demographic details, chief complaints, past medical history, family history, social history, allergies, general examination, risk factors, diagnosis, management will be recruited.
- Based on clinical evaluation, eligible subjects will be hypertensive.
- Clinical features assessed will be: Age, Symptoms, Age of onset of risk factors when applicable.
- Among those subjects meeting the criteria, prevalence of the hypertension in patients will be assessed.
- All the relevant and necessary data was collected in data collection form.

## VI. Results

In this study, 300 cases involving antihypertensive administration were included. Table 6.1 gives demographic characteristics of patients to whom antihypertensives were administered based on age and gender. Maximum number of antihypertensives was administered in the age group of 50-59(26.42%)(illustrated in Fig.6.1) and among 300 cases, males constituted 158(52.66%) and females 142(47.33%) of total cases.

**Table 6.1:** DATA REPRESENTATION OF CHARACTERISTICS OF PATIENTS UNDERGONE ANTIHYPERTENSIVE ADMINISTRATION

| Patient characteristics | Number of cases | | Percentage | |
|---|---|---|---|---|
| Age in years | Males | Females | Males | Females |
| 20-29 | 04 | 08 | 2.53% | 5.63% |
| 30-39 | 24 | 15 | 15.28% | 10.56% |
| 40-49 | 34 | 34 | 21.51% | 23.94% |
| 50-59 | 39 | 40 | 24.68% | 28.16% |
| 60-69 | 37 | 26 | 23.41% | 18.30% |
| ≥70 | 40 | 13 | 25.31% | 09.15% |

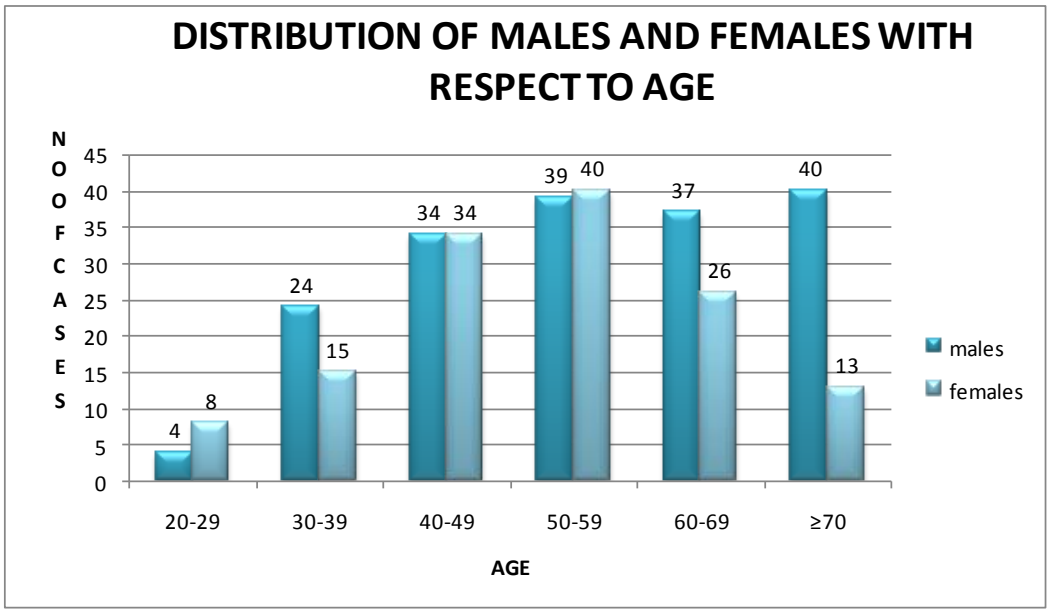


**FIG.6.1:**GRAPHICAL REPRESENTATION OF DISTRIBUTION OF MALES AND FEMALES WITH RESPECT TO AGE

**TABLE 6.2:** DATA DISTRIBUTION BASED ON GENDER DISTRIBUTION

| Gender | Number of cases | Percentage |
|---|---|---|
| Males | 158 | 52.66% |
| Females | 142 | 47.33% |

**FIG. 2:** GENDER DISTRIBUTION

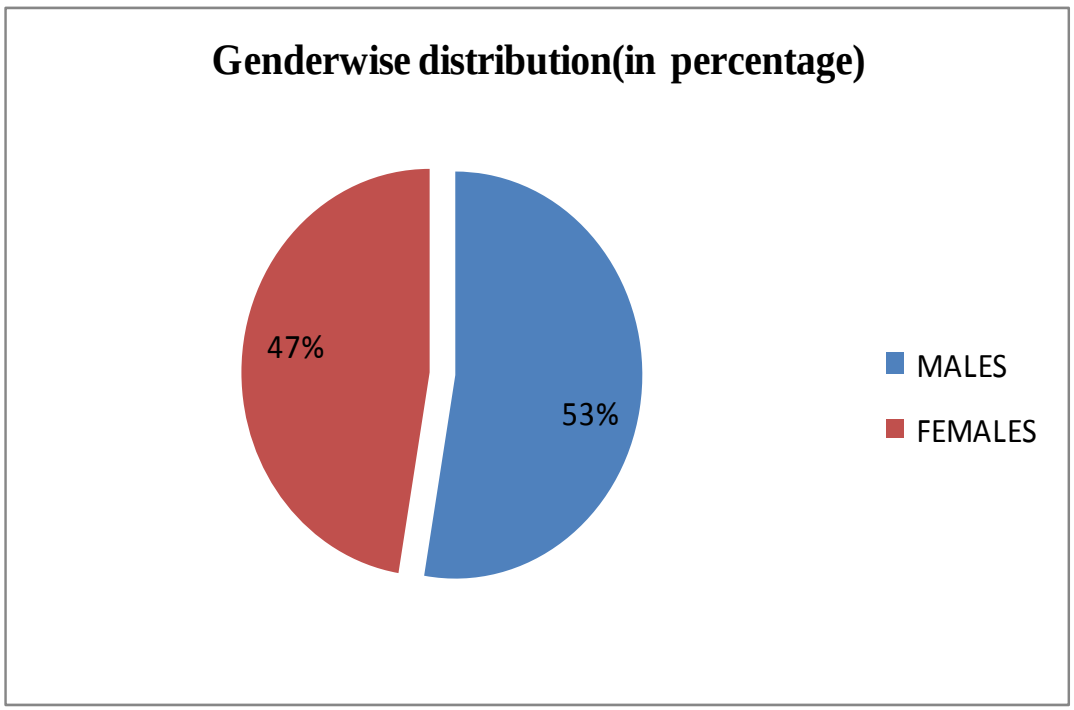


**FIG.6.2:** DIAGRAMMATIC REPRESENTATION OF GENDERWISE DISTRIBUTION

Classification of antihypertensive drugs prescribed in prehypertension, stage I hypertension and stage II hypertension are given in **table 6.3**. Telmisartan was the highest prescribed antihypertensive, 20.24% in prehypertension; 24.29% in stage I Hypertension, 8.50% in Stage II hypertension.

**TABLE 6.3:** CLASSIFICATION OF ANTIHYPERTENSIVE DRUGS PRESCRIBED IN PREHYPERTENSION, STAGE I HYPERTENSION AND STAGE II HYPERTENSION

| Antihypertensive Drug | Pre Hypertension | | Stage I Hypertension | | Stage II Hypertension | |
|---|---|---|---|---|---|---|
| | Total | Percentage | Total | Percentage | Total | Percentage |
| Telmisartan | 48 | 20.24% | 60 | 24.29% | 21 | 8.50% |
| Azlisartan | 01 | 0.04% | 00 | 0 | 00 | 0 |
| Amlodipine | 32 | 12.95% | 35 | 14.17% | 11 | 4.45% |
| Nifedipine | 04 | 1.61% | 02 | 0.80% | 02 | 0.80% |
| Clinidipine | 00 | 0 | 02 | 0.80% | 01 | 0.04% |
| Furosemide | 02 | 0.80% | 08 | 3.23% | 01 | 0.04% |
| Lasilactone | 01 | 0.04% | 00 | 0 | 00 | 0 |
| Metoprolol | 01 | 0.04% | 02 | 0.80% | 01 | 0.04% |
| Propranolol | 02 | 0.80% | 01 | 0.04% | 02 | 0.80% |
| Atenolol | 00 | 0 | 01 | 0.04% | 00 | 0 |
| Enalapril | 01 | 0.04% | 01 | 0.04% | 01 | 0.04% |
| Cardiopril | 00 | 0 | 00 | 0 | 01 | 0.04% |

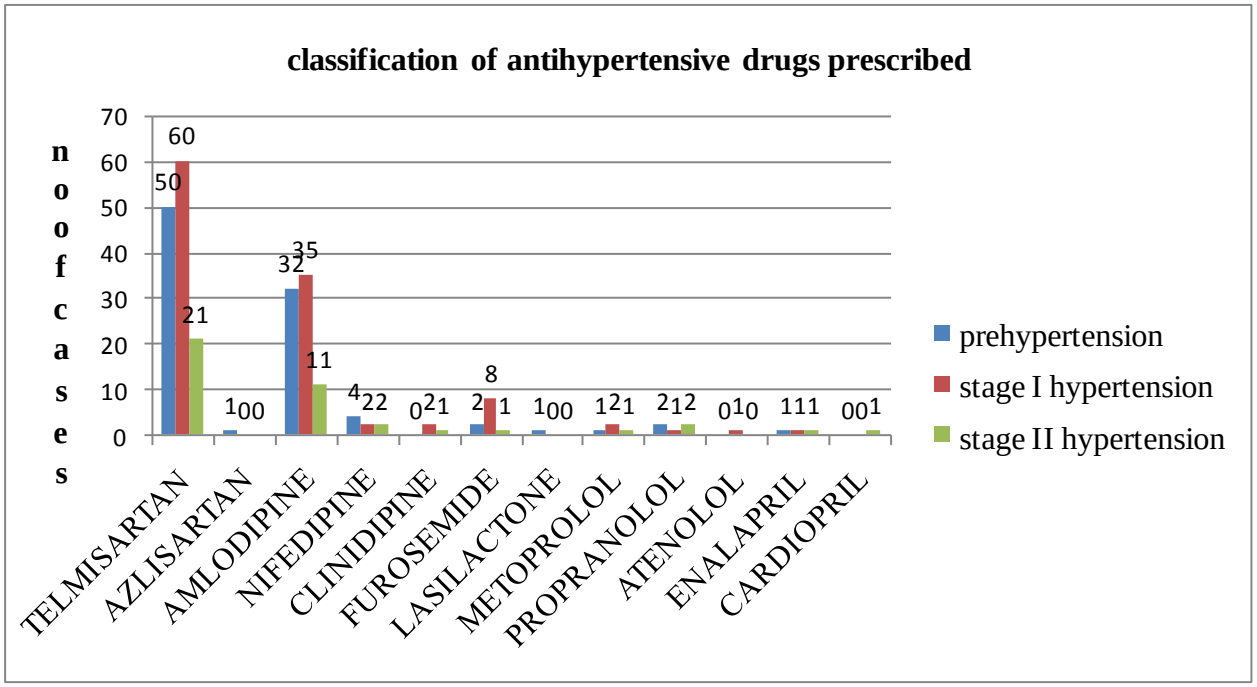


**FIG. 6.3:** GRAPHICAL REPRESENTATION OF CLASSIFICATION OF ANTIHYPERTENSIVE DRUGS PRESCRIBED

Classification of antihypertensive drugs prescribed in males and females are given in **Table 6. 4**. Telmisartan was highly prescribed antihypertensive drug among all the 300 cases constituting 63(39.87%) among males and 62(43.66%) among females, followed by amlodipine 33(20.88%) among males and 35(24.64%) among females. The least prescribed anti-hypertensive drugs was found to be Atenolol constituting just 1 case.

**TABLE 6.4:** CLASSIFICATION OF ANTIHYPERTENSIVE DRUGS PRESCRIBED IN MALES AND FEMALES

| Antihypertensive Drug | Number of cases (males) | Percentage | Number of cases (Females) | Percentage |
|---|---|---|---|---|
| Telmisartan | 63 | 39.87% | 62 | 43.66% |
| Azlisartan | 00 | 00 | 01 | 0.007% |
| Amlodipine | 33 | 20.88% | 35 | 24.64% |
| Nifedipine | 04 | 0.025% | 04 | 0.025% |
| Clinidipine | 02 | 0.012% | 01 | 0.007% |
| Furosemide | 05 | 0.031% | 06 | 0.042% |
| Metoprolol | 02 | 0.012% | 02 | 0.014% |
| Propranolol | 03 | 0.018% | 02 | 0.014% |
| Atenolol | 01 | 0.006% | 00 | 00 |
| Enalapril | 00 | 00 | 03 | 0.02% |
| Cardiopril | 00 | 00 | 01 | 0.007% |

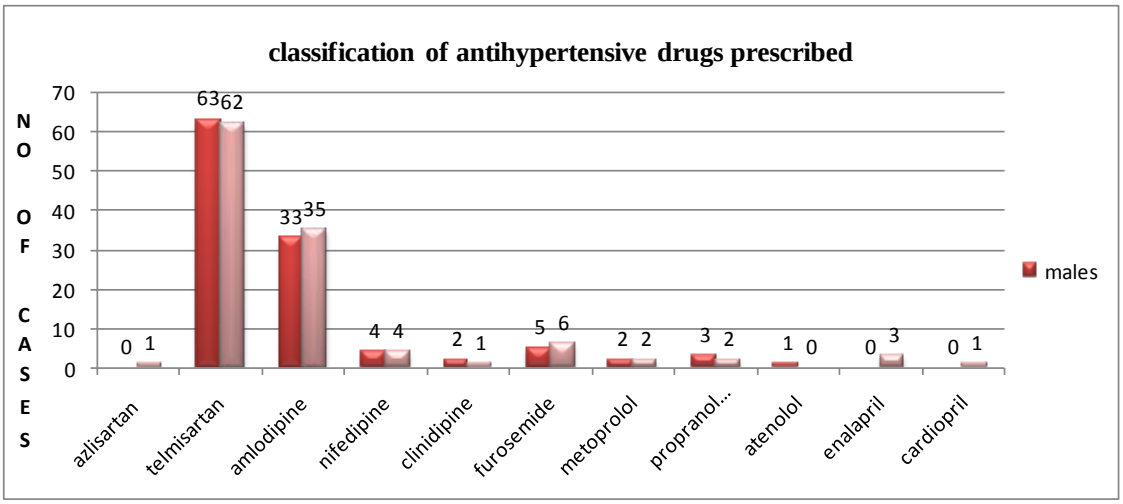


**FIG.6.4:** GRAPHICAL REPRESENTATION OF CLASSIFICATION OF ANTIHYPERTENSIVE DRUGS PRESCRIBED

Classification of antihypertensive classes in males and females are given in **Table 6.5**. Angiotensin Receptor Blockers(ARB's) were the highest prescribed class of antihypertensive drugs among all the 300 cases constituting 63(39.89%) among males and 62(43.66%) among females, followed by Calcium Channel Blockers(CCB's) 39(24.68%) among males and 50(35.21%) among females. The least prescribed class of antihypertensive drug calss was found to be Angiotensin Converting Enzyme Inhibitors(ACEI's).

**TABLE 6.5:** CLASSIFICATION OF ANTIHYPERTENSIVE CLASSES

| Drug Category | Males | | Females | |
|---|---|---|---|---|
| | No. of Cases | Percentage | No. of Cases | Percentage |
| Diuretics | 06 | 0.037% | 06 | 4.22% |
| Angiotensin Receptor Blockers | 63 | 39.89% | 62 | 43.66% |
| Calcium Channel Blockers | 39 | 24.68% | 50 | 35.21% |
| Angiotensin Converting Enzyme Inhibitors | 01 | 0.006% | 03 | 2.11% |
| Beta Blockers | 06 | 3.79% | 05 | 3.52% |

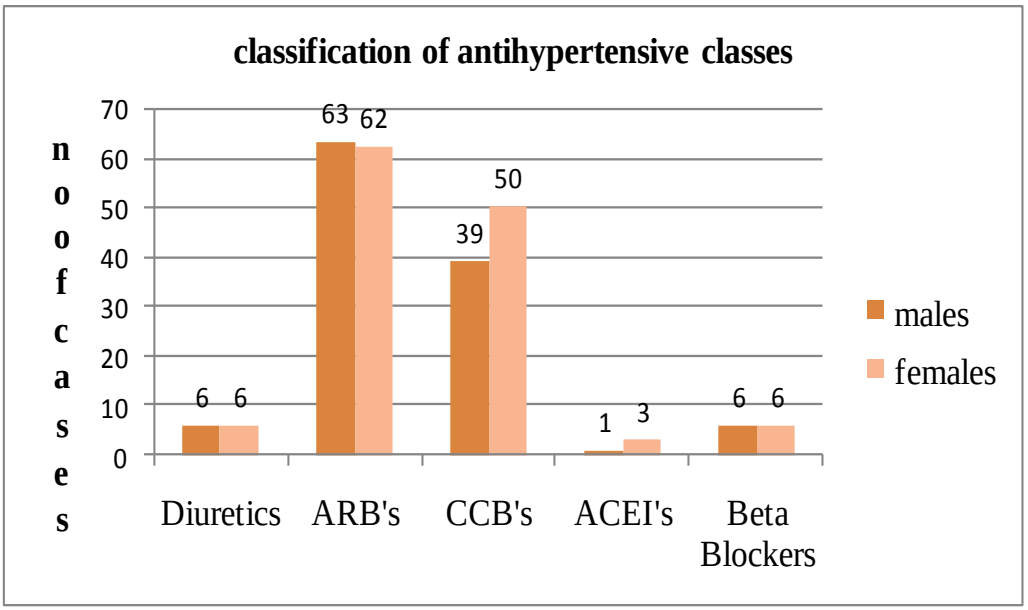


**FIG.9.5:**GRAPHICAL REPRESENTATION OF CLASSIFICATION OF ANTIHYPERTENSIVE CLASSES

The detailed description of type of antihypertensive therapy used is in **Table 6.6.** They are categorized into single drug therapy, two drug therapy and multi drug therapy. When the cases were screened thoroughly, the number of cases of single drug therapy was 247(82.33%),no of cases of two drug therapy was 47(15.66%) and no of cases of multidrug therapy was 06(02%).

**TABLE 6.6:** SINGLE ANTIHYPERTENSIVE THERAPY vs. MULTIPLE DRUG ANTIHYPERTENSIVE THERAPIES

| Drug therapy | No of prescriptions | Percentage of prescriptions |
|---|---|---|
| Single drug therapy | 247 | 82.33% |
| Two drug therapy | 47 | 15.66% |
| Three drug therapy | 03 | 01% |
| Four drug therapy | 03 | 01% |

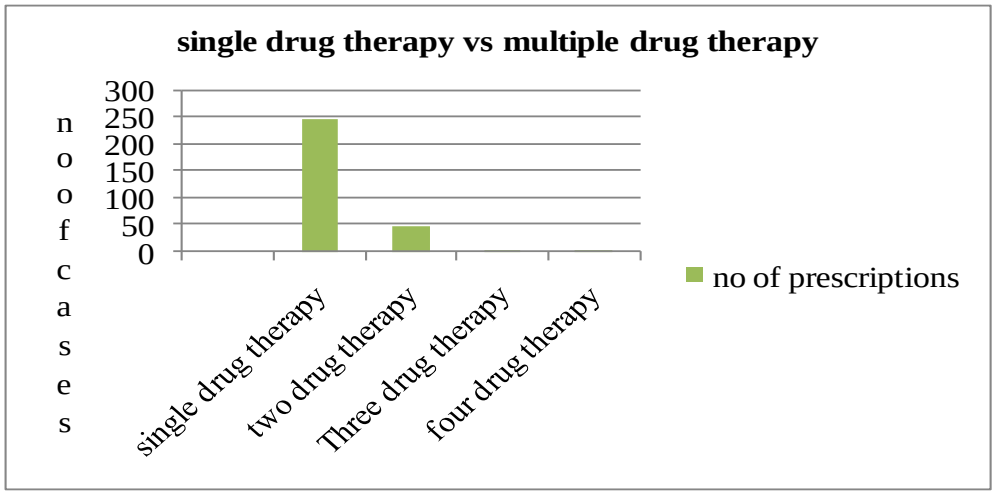


**FIG.6.6:** SINGLE DRUG THERAPY vs MULTIPLE DRUG THERAPY

## VII. Discussion

In this study, 300 cases involving patients undergoing antihypertensive therapy was encountered. Most of the male patients were above 70 years(25.31%) and most of the female patients were between 50-59(28.16%). Patients younger than 50 years accounted for 39.72% of total cases whereas patients older than 70 accounted for 11.07% of total cases. Men made up 53% while women made up 47% of total collected cases.

The most utilized drugs were Angiotensin Receptor Blockers which were utilized in 41.77%, Calcium Channel Blockers 34.17%, Beta Blockers 3.65% and Diuretics 2.12%, the same observation was noticed in the study conducted by Ajmal Mankadavath [2].These are all first line drugs for hypertension treatment. Angiotensin Converting Enzymes were the least utilized in 0.006% of total cases.

**The utilization of antihypertensive drugs was as follows**

The utilized drugs in all cases were Telmisartan 125(83.53%), Amlodipine 68(45.52%), Furosemide 11(0.073%), Nifedipine 08(0.05%), Propranolol 05(0.032%), Metoprolol 04(0.026%) and Clinidipine 03(0.0019%).

Among the 300 patients, 247(82.33%) patients received monotherapy, the same observation was noticed in the study conducted by D. Bhvaika [5] and other 53(17.66%) patients received a combination therapy.

Stage I hypertension 112(45.34%) cases was predominant than Prehypertension 94(38.05%) cases and Stage II hypertension 41(16.59%), the same observation was noticed in the study conducted by Sai Supraneni [15].There are specific drugs recommended for hypertension with compelling indication. In all the cases with diabetes mellitus or myocardial infarction or heart failure as compelling indications, patients were given at least 1 recommended drug.

## VIII. Limitations

- Lack of control group.
- Single centre study.
- Lack of follow up over a prolonged period of time.

## IX. Conclusion

As there is a strong epidemic rise in hypertension in our country, the present prospective study was carried out to assess the current trends in utilization patterns of antihypertensive drugs in the treatment of hypertension. In this study, post analysis of 300 case sheets, denoted that the physicians preferred single drug therapy more than multiple drug therapy and the most frequently prescribed class was Angiotensin Receptor Blockers class of antihypertensive agents. Among Angiotension Receptor Blockers, Telmisartan was the most frequently utilized antihypertensive drug(83.53%). More attention should be paid to following guidelines for treatment of hypertension with compelling indications and treatment of hypertension cases based on stage of hypertension.

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**ANNEXURE**

**PATIENT DATA COLLECTION FORM**

DATE: IP NUMBER:

PATIENT NAME : AGE : SEX:

ADDRESS: HEIGHT: WEIGHT:

PATIENT COMPLAINTS:

SOB- YES/NO HEADACHE- YES/NO

DIZZINESS- YES/NO VISUAL CHANGES- YES/NO

RISK FACTORS: DM: THYROID PROBLEM:

HLP: CVA:

ANY OTHER CO-MORBID ILLNESS: RENAL PROBLEM:

FAMILY HISTORY

VITALS: BP: mmHg PULSE RATE: BPM TEMP:

**LABORATORY DATA**

| HEMATOLOGY | | CUE | | ELECTROLYTES | |
|---|---|---|---|---|---|
| Hb: | 12-18 gm% | physical: | | Na(136-145mEq/L) | |
| RBC: | 3.6-6.0 m/cmm | appearance: | | K(3.5-5.0mEq/L) | |
| T.WBC: | 4000-11000c/c | colour: | | Cl(97-111mEq/L) | |
| DLC: N: | 45-75% | Reaction: | | Ca(8.5-11.0mg/Dl) | |
| L: | 20-45% | sp. Gravity: | | THYROID FUNCTION | |
| E: | 1-6% | chemical: | | $T_3$: | |
| M: | 1-9% | albumin: | | $T_4$: | |
| B | 0-1% | epithelial cells: | | TSH: | |
| PLT: | 1.5-4.5 L/C | pus cells: | | | |

DIAGNOSIS:

**HYPERTENSIVE MEDICATION**

| DRUG | GENERIC NAME | DOSE | FREQUENCY | ROA | DOA | DOS | COMMENTS |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**OTHER MEDCIATION**

| DRUG | GENERIC NAME | DOSE | FREQUENCY | ROA | DOA | DOS | COMMENTS |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
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