A Prospective Observational Study on Magnitude and Pattern of Hypertension among Type 2 Diabetics and Non Diabetics

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Abstract

Methodology: A Prospective observational study was carried out at Osmania General Hospital for a period of 6 months. All patients of either sex attending general medicine department with established hypertension with and without diabetes above 35 years of age were included. Patients below 18 years of age, Pregnant and lactating women and patients who refused to be a part of the study were excluded. **Results:** During the study period, a total of 150 Patients were enrolled. Out of which 65% were males and 35% were females and common age group was ≥60 years. Prevalence of macro vascular complications was found to be more in diabetic patients which is 62%. It was found that 63% have HTN for a duration of >2 years, 56% had no knowledge about their medications, 61% have treatment complexity and 96% have macro vascular complications. Diuretics were the most commonly prescribed class of drugs. It was reported that 55% were adherent to HTN medication, 34% were not following low salt diet, non-adherence to physical activity was 46%, adherence to non- smoking was 61% and 53% of the patients were not adhered to alcohol abstinence. **Conclusion:** Magnitude of HTN is high among old aged diabetic males with predicted high risk of macrovascular complications. The reasons for the uncontrolled BP were poor knowledge of hypertension, medications, alcohol abstinence, low salt diet, stress, physical activity and older age. Clinical pharmacist at an early stage can monitor the BP and diabetic related risk factors, thereby enhancing the quality life span of the patient and can help in reducing the burden of costly drugs.

Keywords
Coronary heart disease, Clinical Pharmacist, Diabetes, Hypertension, Stroke.

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INTRODUCTION:
1. Hypertension
1.1 Background
According to the American Heart Association (AHA), approximately 86 million adults (34%) in the United States are affected by hypertension, which is defined as a systolic blood pressure (SBP) of 140 mm Hg or more or a diastolic blood pressure (DBP) of 90 mm Hg or more, taking antihypertensive medication, or having been told by clinicians on at least 2 occasions as having hypertension. Substantial improvements have been made with regard to enhancing awareness and treatment of hypertension. However, a National Health Examination Survey (NHANES) spanning 2011-

2014 revealed that 34% of US adults aged 20 years and older are hypertensive and NHANES 2013-2014 data showed that 15.9% of these hypertensive adults are unaware they are hypertensive; these data have increased from NHANES 2005-2006 data that showed 29% of US adults aged 18 years and older were hypertensive and that 7% of these hypertensive adults had never been told that they had hypertension [1].

Data from the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7), which was released in 2003, were relatively similar to the NHANES data. The JNC 7 noted that approximately 30% of adults were unaware of their hypertension; up to 40% of people with hypertension were not receiving treatment; and, of those treated, up to 67% did not have their BP controlled to less than 140/90 mm Hg [2].

Hypertension:
Definition and Classification
Hypertension (**HTN**) also known as high blood pressure, is a long-term medical condition in which the blood pressure in the arteries is persistently elevated [3]. High blood pressure typically does not cause symptoms [4]. Long-term high blood pressure, however, is a major risk factor for coronary artery disease, stroke, heart failure, atrial fibrillation, peripheral vascular disease, vision loss, chronic kidney disease, and dementia [5]. Known the "silent killer," hypertension usually has no signs or symptoms and many people are not aware they have it. *A blood pressure that is higher than 140/90 needs to be monitored, especially if it occurs with diabetes.* High blood pressure increases a person's risk of stroke and heart attack. It often occurs with diabetes [6]. Based on recommendations of the JNC 7, the classification of BP (expressed in mm Hg) for adults aged 18 years or older is as follows: [Fig 1]

Classification	Systolic (mm Hg)		Diastolic (mm Hg)
Normal	<120	and	<80
Prehypertension	120–139	or	80–89
Stage 1 hypertension	140–159	or	90–99
Stage 2 hypertension	≥160	or	≥100

Fig 1: Classification of Blood Pressure in Adults [7]

1.2 Essential Hypertension
Over 90% of individuals with high BP have essential hypertension. Numerous mechanisms have been identified that may contribute to the pathogenesis of this form of hypertension, so identifying the exact underlying abnormality is not possible. Genetic factors may play an important role in the development of essential hypertension. There are monogenic and polygenic forms of BP dysregulation that may be responsible for essential hypertension. Many of these genetic traits feature genes that affect sodium balance, but genetic mutations altering urinary kallikrein excretion, nitric oxide release, and excretion of aldosterone, other adrenal steroids, and angiotensinogen are also documented. In the future, genetic testing for these traits could lead to alternative approaches to preventing or treating hypertension; however, this is not currently recommended [8, 9].

Secondary Hypertension
Fewer than 10% of patients have secondary hypertension where either a comorbid disease or a drug (or other product) is responsible for elevating BP. In most of these cases, renal dysfunction resulting from severe chronic kidney disease (CKD) or renovascular disease is the most common secondary cause. Certain drugs (or other products), either directly or indirectly, can cause hypertension or exacerbate hypertension by increasing BP. When a secondary cause is identified, removing the offending agent (when feasible) or treating/correcting the underlying comorbid condition should be the first step in management [9].

1.3 Signs And Symptoms:
General: The patient may appear healthy or may have the presence of additional CV risk factors:
- Age (≥55 years for men, ≥65 years for women)
- Diabetes mellitus
- Dyslipidemia
- Albuminuria
- Family history of premature CV disease
- Obesity (body mass index [BMI] ≥30 kg/m^2)
- Physical inactivity
- Tobacco use Symptoms: Usually none related to elevated BP

1.4 Pathophysiology

Multiple factors that control BP are potential contributing components in the development of essential hypertension. These include malfunctions in either humoral (i.e., the renin–angiotensin–aldosterone system [RAAS]) or vasodepressor mechanisms, abnormal neuronal mechanisms, defects in peripheral autoregulation, and disturbances in sodium, calcium, and natriuretic hormone. Many of these factors are cumulatively affected by the multifaceted RAAS, which ultimately regulates arterial BP. It is probable that no one factor is solely responsible for essential hypertension [9]. [Fig 2]

Blood pressure (BP) is the mathematical product of cardiac output and peripheral resistance. Elevated BP can result from increased cardiac output and/or increased total peripheral resistance.

Increased cardiac output
Increased cardiac preload:
- Increased fluid volume from excess sodium intake or renal sodium retention (from reduced number of nephrons or decreased glomerular filtration)

Venous constriction:
- Excess stimulation of the renin–angiotensin–aldosterone system (RAAS)
- Sympathetic nervous system overactivity

Increased peripheral resistance
Functional vascular constriction:
- Excess stimulation of the RAAS
- Sympathetic nervous system overactivity
- Genetic alterations of cell membranes
- Endothelial-derived factors

Structural vascular hypertrophy:
- Excess stimulation of the RAAS
- Sympathetic nervous system overactivity
- Genetic alterations of cell membranes
- Endothelial-derived factors
- Hyperinsulinemia resulting from the metabolic syndrome

Fig 2: Potential Mechanisms of Pathogenesis [9]

Humoral Mechanisms
Several humoral abnormalities involving the RAAS, natriuretic hormone, and hyperinsulinemia may be involved in the development of essential hypertension [10].

The Renin–Angiotensin–Aldosterone System
The RAAS is a complex endogenous system involved with most regulatory components of arterial BP. Activation and regulation is primarily governed by the kidney. The RAAS regulates sodium, potassium, and blood volume. Therefore, this system significantly influences vascular tone and sympathetic nervous system activity, and is the most influential contributor to the homeostatic regulation of BP. [Fig 3]
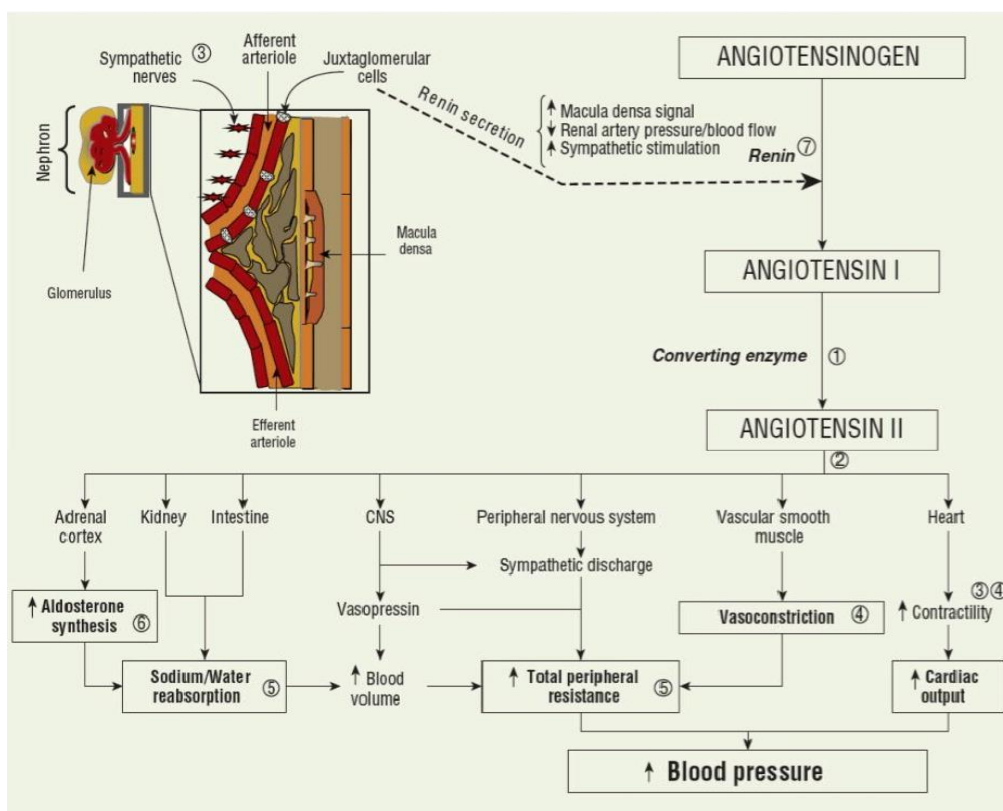

Fig. 3: Diagram Representing the Renin-Angiotensin-Aldosterone System [9]

1.5 Prevention

The 2004 British Hypertension Society guidelines [11] proposed lifestyle changes consistent with those outlined by the US National High BP Education Program in 2002[12] for the primary prevention of hypertension:

- maintain normal body weight for adults (e.g. body mass index 20–25 kg/m^2)
- reduce dietary sodium intake to <100 mmol/ day (<6 g of sodium chloride or <2.4 g of sodium per day)
- engage in regular aerobic physical activity such as brisk walking (≥30 min per day, most days of the week)
- limit alcohol consumption to no more than 3 units/day in men and no more than 2 units/day in women
- Consume a diet rich in fruit and vegetables (e.g. at least five portions per day) [11].

1.6 Treatment

- The JNC 7 guidelines recommend BP goals for the management of hypertension. A goal BP of
- <140/90 mm Hg is recommended for most patients for general prevention of CV events or CV disease (e.g. coronary artery disease) [9]. [Fig 4] [Fig 5]
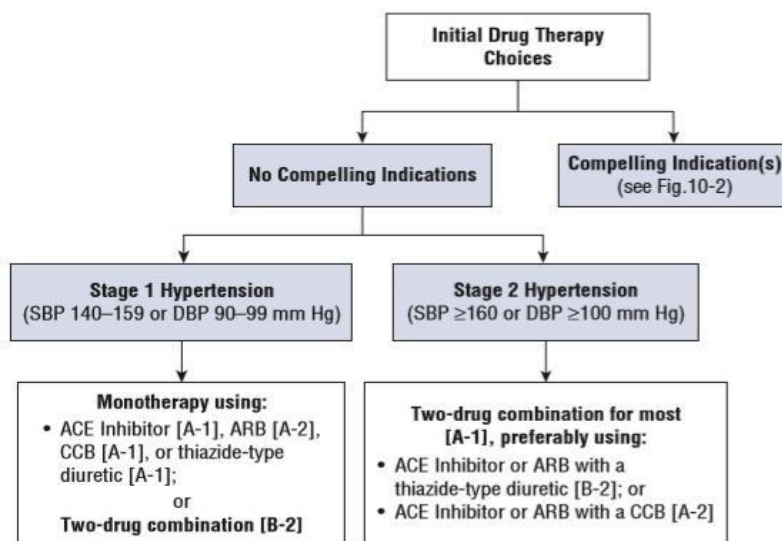
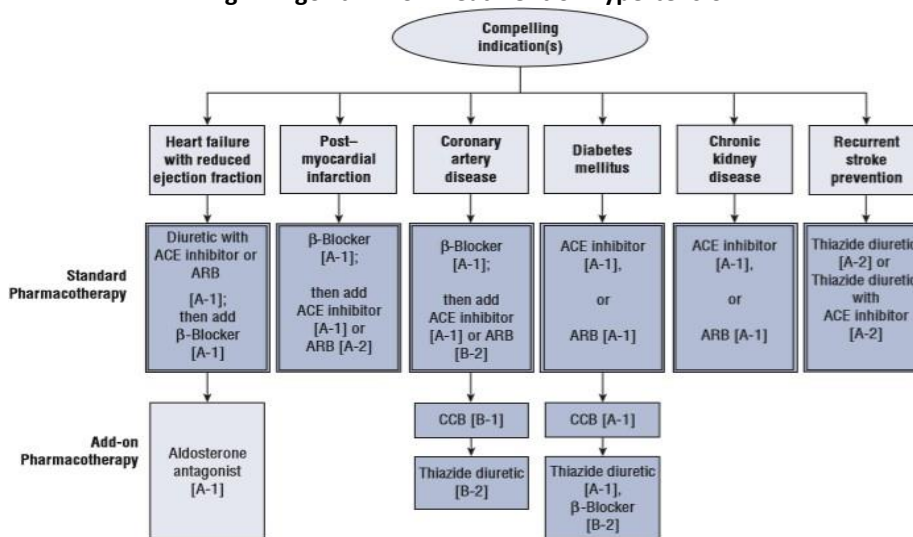**Fig 4**: **Algorithm for Treatment of Hypertension** [7]

Fig 5: Compelling Indications for Individual Drug Classes [7]

Aim and Objectives:

- The objective was to study the magnitude and pattern of hypertension among diabetic patients and non- diabetic patients and their drug utilization pattern.
- Importance of BP control & other factors in lowering incidence and retarding the progression of macro vascular complications in decreasing the risk of morbidity and mortality.
- Risk prediction of macro vascular complications.

Need for the study:

Hypertension and diabetes are two of the leading risk factors for atherosclerosis and its complications, including heart attacks and strokes. Therefore there was the need to carry out the study for the following reasons.

- To assess the link between hypertension and diabetes and evaluate the risk prediction for stroke and cardiovascular diseases.
- For overall understanding and effectiveness of therapy by using the data from the patients and their caretakers.
- To check the rationality of the prescription and to study the impact of JNC 8 guidelines in relieving the symptoms and subsiding disease progression to improve health related quality of life.
- Importance of controlling BP and lifestyle modifications in macro vascular complications.
- To improve the outcome of quality of life with patient counselling.

METHODOLOGY

A Prospective and Observational study was carried out in the Department of General Medicine, at

Osmania General Hospital, Hyderabad, Telangana State for a period of 6 months with a sample size of 150 patients.

Materials and Methods
- Suitable Data collection forms were prepared and the data collection was done in the prepared forms.
- Follow up of Patients is done to Evaluate
- Assessment and Rationality of Prescription
- Assessment and Classification of Collected Data
- Evaluation and Analysis of Collected Data

Data Analysis
- Data Analysis is done based on the Parameters assessed and analysed.
- The data results are represented using tables and graphical data

Plan of Work:

Suitable Data Collections forms were prepared/ modified to collect the details on following

↓

Follow up of Patients is done to Evaluate

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Assessment and Rationality of Prescription

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Assessment and Classification of Collected Data

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Evaluation and Analysis of Collected Data
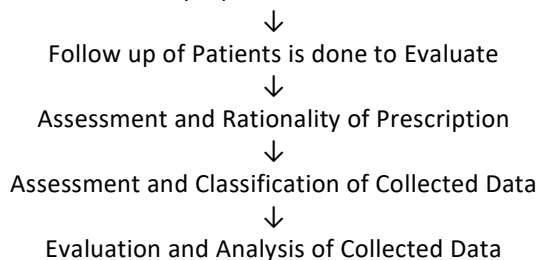
RESULTS:

The primary sites of action for major antihypertensive agents are included: 1.ACE inhibitors; 2.Angiotensin II receptor blockers; 3.B-blockers; 4.Calcium channel blockers; 5.Diuretics; 6.Aldosterone antagonists; 7.Direct renin inhibitors.

Majority of the patients were found in the age group of ≥60 years with prehypertension having systolic BP as 120-139mmHg and diastolic BP as 80-90mmHg which accounts for 25%.

Table 1: Age - Wise Distribution of Patients

Age (in years)	Number of Patients	Percentage %
35-40 years	10	7%
41-59 years	61	41%
≥60 years	79	52%

Table 2: Age – Wise Distribution Of Patients Based On Their Systolic And Diastolic Pressure

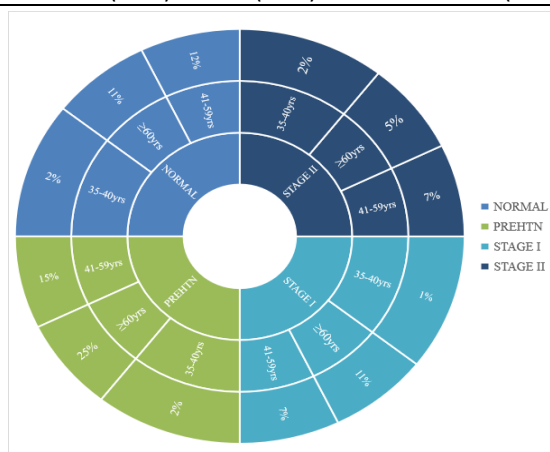| Category	Normal	Prehypertension	Stage I HTN	Stage II HTN
SBP Values	<120	120-139	140-159	≥160
DBP Values	<80	80-89	90-99	≥100
Age group (in years)				
35-40	3 (2%)	3 (2%)	1 (1%)	3 (2%)
41-59	18 (12%)	22 (15%)	11 (7%)	10 (7%)
≥60	17 (11%)	38 (25%)	16 (11%)	8 (5%)

Fig 6: Age- Wise Distribution of Patients Based on Their Systolic and Diastolic Pressure

Table 3: Gender - Wise Distribution of Patients Based On Their Systolic And Diastolic Pressure

Category	Normal	Prehypertension	Stage I HTN	Stage II HTN
SBP Values	<120	120-139	140-159	≥160
DBP Values	<80	80-89	90-99	≥100
Gender				
Males	22 (15%)	42 (28%)	17 (11%)	17 (11%)
Females	16 (11%)	21 (14%)	11 (7%)	4 (3%)

Table 4: Distribution Based on Sociodemographic Characteristics of Hypertensive Patients

Variables	Category	Frequency	Percentage
Marital status	Single	5	3%
	Married	145	97%
Diet	Vegetarian	21	14%
	Mixed	129	86%
Employment status	Employed	98	65%
	Unemployed	52	35%
Stress	Present	88	59%
	Not Present	62	41%

Table 5: Distribution of Patients Based on Addictions

Addictions	Number of Patients	Percentage
SMOKERS	45	30%
ALCOHOLIC	59	39%
TOBACCO CHEWER	21	14%

Table 6: Prevalence of Complication In Diabetic And Non Diabetic Patients

Category	Prevalence of Complication (Frequency)	Prevalence of Complication (Percentage)
DIABETIC	57	38%
NON DIABETIC	93	62%

Table 7: Risk Stratification Based on Blood Pressure Values

Category	Normal	Prehypertension	Stage I	Stage II
BLOOD PRESSURE (mmHg)	SBP <120 or DBP <80	SBP 120-139 or DBP 80-89	SBP 140-159 or DBP 90-99	SBP ≥160 or DBP ≥100
Percentage	38 (25%)	63 (42%)	28 (19%)	21 (14%)
Risk strata*	Low risk	Medium risk	High risk	Very High risk

*Risk strata (typical 10-year risk of stroke and myocardial infarction): Low risk = Less than 15%, Medium risk = about 15-20%, High risk = about 20-30% Very high risk = ≥30%

Table 8: Distribution of Data Based On Comorbidity

Comorbidity	Patients	Percentage
CV Disorders	33	22%
CNS Disorders	85	57%
Endocrinology Disorders	20	13%
Respiratory Tract Infections	16	11%
GI Disorders	7	5%
Blood Disorders	7	5%
Liver Diseases	6	4%
UTI	2	1%
Other Infections	3	2%

Table 9: Distribution Based on Information, Medication And Clinical Characteristics Of Respondents

Variable	Category	Frequency	Percentage (%)
Duration with HTN	< 2 years	56	37%
	> 2 years	94	63%
Taking medications for HTN	YES	99	66%
	NO	51	34%
Knows about medicine	YES	66	44%
	NO	84	56%
Presence of comorbidity	YES	89	59%
	NO	61	41%
Treatment complexity	YES	91	61%
	NO	59	39%
Outcome as complications	YES	144	96%
	NO	6	4%

Table 10: Distribution of Class Of Drugs Based On Monotherapy And Combined Therapy

Class Of Drugs	Mono therapy (Percentage)	Combined Therapy (Percentage)
ACE I	30%	21%
ARBs	11%	11%
CCB	47%	21%
β-Blocker	21%	16%
Diuretics	58%	38%
α-Blocker	0%	0%
Centrally Acting	3%	0%
α+β Blocker	1%	1%

Table 11: Distribution Based on Prescribing Pattern of Combination of Class Of Drugs In Hypertensive Diabetic Patients

Combination Of Class	Frequency	Percentage
ACE I + CCBs	3	4%
ACE I + Diuretics	15	20%
ARBs + Diuretics	3	4%
CCBs + Diuretics	7	9%
β – Blockers + ACE I	4	5%
β – Blockers + ARBs	1	1%
β – Blockers + Diuretics	14	19%
β – Blockers + CCBs	2	3%

Table 12: Distribution Based on Prescribing Pattern of Combination of Class Of Drugs In Hypertensive Non Diabetic Patients

Combination Of Class	Frequency	Percentage
ACE I + ARBs	2	3%
ACE I + Diuretics	9	12%
ACE I + CCBs	10	13%
ARBs + Diuretics	4	5%
ARBs + CCBs	7	9%
Diuretics + CCBs	17	23%
β – Blockers + ACE I	4	5%
β – Blockers + ARBs	2	3%
β – Blockers + Diuretics	5	7%
α+ β Blockers + CCBs	2	3%

Table 13: Distribution Based on Prescribing Pattern of Drugs in Hypertensive Diabetic Patients

Drugs	Frequency	Percentage
Enalapril	26	35%
Telmisartan	3	4%
Mannitol	11	15%
Furosemide	24	32%
Aldactone	9	12%
Amlodipine	22	29%
Nifedipine	1	1%
Metoprolol	9	12%
Atenolol	3	4%
Carvedilol	2	3%
Clonidine	2	3%

Table 14: Distribution Based on Prescribing Pattern of Drugs in Hypertensive Non Diabetic Patients

Drugs	Frequency	Percentage
Enalapril	26	35%
Telmisartan	9	12%
Mannitol	23	31%
Furosemide	15	20%
Aldactone	5	7%
Amlodipine	39	52%
Nifedipine	4	5%
Metoprolol	13	17%
Atenolol	2	3%
Labetolol	2	3%

Table 15: Participants Adherence Status on Self-Care Behaviours (Prevalence Rates on Self-Care Activity) Among Adult Patients

Variables	Category	Frequency	Percentage (%)
Medication Adherence	Adherence	83	55%
	Non-Adherence	67	45%
Low salt diet	Adherence	99	66%
	Non-Adherence	51	34%
Physical activity	Adherence	81	54%
	Non-Adherence	69	46%
Non-Smoking adherence	Adherence	91	61%
	Non-Adherence	59	39%
Alcohol Abstinence Adherence	Adherence	71	47%
	Non-Adherence	79	53%

RESULT AND DISCUSSION:

Our study identified the pattern of hypertension among diabetics and non-diabetics in 150 patients admitted in a tertiary care teaching hospital. Among 150 patients that were included in our study, a significantly high number of hypertensive patients were found in the age group of ≥60 years which accounts for 52% followed by age groups 41-59 years (41%) and 35-40 years (7%) which was similar to a study by Madhu et.al. (2014)[13]. When a study on age-wise distribution of patients based on systolic and diastolic blood pressure was conducted, majority of the patients were found in the age group of ≥60 years with prehypertension having systolic BP as 120-

139mmHg and diastolic BP as 80-90mmHg which accounts for 25%. This trend is comparable to the study of Madhu et.al. (2014)[13].

The prevalence of HTN is found more in males (65%) which was found different from the study by Madhu et.al. (2014)[13]. When a study on gender-wise distribution of patients based on systolic and diastolic blood pressure was conducted, it was found that majority of the patients were males having prehypertension having systolic BP as 120-139mmHg and diastolic BP as 80-90mmHg which accounts for 28%. This is comparable to a study by Madhu et.al. (2014)[13].

In our study, majority of the patients, 145 patients (97%) were married and 129 patients (86%) have mixed diet. About 98 (65%) of patients were employed and 88 (59%) patients have stress. The results of employed and married patients were found similar to a study by Birgit J.T (2017) [14]. Majority of the patients (39%) were alcoholic followed by smokers (30%) and 14% were found to be tobacco chewers which is similar to a study by Oladele V.A. et.al. (2016)[15].

In the present study, majority of the patients with both diabetes and hypertension were known cases but the next highest number was that of subjects with known diabetics who were newly diagnosed with hypertension. The assessment among 150 hypertensive patients was found that 93 hypertensive patients (62%) with diabetes developed macrovascular complications, 57 hypertensive patients (38%) without diabetes developed macrovascular complications. These results varied with the results found in a study by Kretzer, K. et.al. (2008)[16].

In our study, we found 25% of the patients have low risk, 42% shows a medium risk, 19% of the patients show high risk and 14% of the patients show a very high risk of macrovascular complications. The prognosis of patient and the choice and need for urgency of therapy are dependent on the overall risk stratification. The risk stratification revealed that all diabetics with SBP of ≥140 have a typical 10 year high risk of Stroke or MI. This trend was similar to study by Madhu et al., (2014) [13].

We assessed that majority of the subjects had comorbidities like CNS disorders like stroke (57%) followed by CVDs (22%), endocrinological disorders (13%), RTI (11%), GI disorders (5%), blood disorders (5%), liver disorders (4%), UTI (1%) and others (2%). This study was dissimilar with a study by Abegaz T.M et.al. (2018)[17].

94 (63%) patients of our present study had the duration of >2 years of HTN and 99 patients (66%) were taking medications out of which 84 (56%) patients had no knowledge about their medications. Majority of the patients 89 (59%) had comorbid condition, 91 patients (61%) had treatment complexity and 144 patients (96%) had macrovascular complications as their outcomes. These results matched with a study by Habtamu A.H. et.al. (2014)[18].

The most common prescribed route was found to be oral route. In our study various classes of drugs were prescribed and the most commonly prescribed class of drug was found to be diuretics (58%) both in monotherapy and combined therapy followed by calcium channel blockers (47%), ACE inhibitors (30%), ARBs (11%), β - blockers (21%), centrally acting vasodilators (3%) and α + β blockers (1%). These results varied with the results by Kretzer, K. et.al. (2008)[16].

We assessed the prescribing pattern both in diabetic and non-diabetic patients. In diabetic patients, combination of ACE inhibitors and diuretics (20%) was commonly prescribed and enalapril was the most commonly prescribed drug (35%). In non-diabetic patients, combination of diuretics and calcium channel blockers was commonly prescribed (23%) and amlodipine was the most commonly prescribed drug (52%). These results varied with the results by Kretzer, K. et.al. (2008)[16].

More than half of the patients, 55%, were reported as adherent to hypertension medication, 34% were not following low salt diet and non-adherence to physical activity was 46%. More than two third, 61%, of the population were non-smokers. Majority, 53% of the patients were not adhered to alcohol abstinence. A similar trend was found in a study by Tesfaye B et.al. (2017) with differences in low salt diet and alcohol abstinence adherence [19].

CONCLUSION:

Magnitude of HTN is high among old aged diabetic males with predicted high risk of stroke and coronary heart disease events. When a study on age-wise and gender-wise distribution of patients based on systolic and diastolic blood pressure was conducted, majority of the patients were found in the age group of ≥60 years and were males with prehypertension having systolic BP as 120-139mmHg and diastolic BP as 80-90mmHg. We assessed the patients among various sociodemographic characters and found that most of the patients were married, have mixed diet, were employed and have stress. Apart from majority of the patients being alcoholic, the prevalence of macrovascular complications was high among diabetic patients.

Our study showed that majority of the patients had duration of >2 years of HTN. Most of the patients

were taking medications but majority had no knowledge about medications and had treatment complexity. The most commonly prescribed anti-hypertensive were found to be diuretics, CCBs, ACE inhibitors followed by β-blockers. In diabetic patients, combination of ACE inhibitors and diuretics was commonly prescribed and enalapril was the most commonly prescribed drug. In non-diabetic patients, combination of diuretics and calcium channel blockers was commonly prescribed and amlodipine was the most commonly prescribed drug. The reasons for the uncontrolled BP were poor knowledge of hypertension related complications, medications, non-adherence to alcohol abstinence, non-adherence to low salt diet, more stress, less physical activity and older age. Clinical pharmacist at an early stage can monitor the BP and diabetic related risk factors, thereby enhancing the quality life span of the patient and can help in reducing the burden of costly drugs. Continuous health education, patient counselling and information regarding adherence and satisfaction of the patients in each follow up is very essential to avert the problem.

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