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Evaluation on Safety and Efficacy of Selective Anti-Hypertensive Drugs in Patients with Cardiovascular Disease at a Tertiary Care Hospital, India-an Observational Study

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Authors' contributions

This work was carried out in collaboration among all authors. Author REU had done the designing of study and had provided the facilities for the study. Author UI had done the protocol preparation, data collection, data management, data analysis and determination of final conclusion. Author MB had done the data collection, data management and data handling. Author CBR had obtained the Institutional ethics committee approval. Author KCN had done the review of the study. All authors read and approved the final manuscript.

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ABSTRACT

Background: Hypertension means persistent elevation of Blood Pressure in arteries. It is the second leading cause of death. The symptoms include Severe Headache, Drowsiness, Vision problem, Nose bleed, fatigue, Confusion. It may lead to various types of Cardiovascular disorders such as Myocardial Infarction, Coronary Artery Disease, Heart Failure. The treatment of Hypertension can be done by Anti-Hypertensive Drugs which include Angiotensin -II Receptor Blockers, Beta Blockers, Angiotensin Converting Enzyme Inhibitors etc.

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Results: We have done the study to find out the safe and effective drug among various categories of Anti-Hypertensive drugs to treat hypertension in various cardiovascular disease patients. We have collected sample size of 220 out of which 100 were Myocardial Infarction patients,100 were coronary artery disease patients and 20 were Heart Failure patients.
The categories of anti-hypertensive drugs selected for our study were Angiotensin-II Receptor Blockers, Beta Blockers and Angiotensin Converting Enzyme Inhibitors. Angiotensin-II Receptor Blockers were prescribed to 31 Myocardial Infarction patients, 31 coronary artery disease patients,8 Heart Failure patients. Beta Blockers were prescribed to 58 Myocardial Infarction patients,58 coronary artery disease patients,7 Heart Failure patients. Angiotensin Converting.
Enzyme Inhibitors were prescribed to 10 Myocardial Infarction patients,10 Coronary Artery Disease patients,5 Heart Failure patients.
Conclusion: From all the observations, Beta Blockers were observed to be the drugs with maximum efficacy and maximum safety.

Keywords: Hypertension; myocardial infarction; coronary artery disease; heart failure; beta blockers.

ABBREVIATIONS

SP : Systolic Pressure
DP : Diastolic Pressure
CVD : Cardiovascular Disease
ACE Inhibitors : Angiotensin Converting Enzyme Inhibitors
ARBs : Angiotensin-II Receptor Blockers
CAD : Coronary artery disease
MI : Myocardial Infarction

1. INTRODUCTION

Hypertension which is also called as high blood pressure is defined as the persistent elevation of blood pressure in the arteries [1]. Complex interaction of genes and environmental factors results in hypertension. Some rare genetic variants with large effects and the numerous common variants with small effects on hypertension had been identified [2]. In established hypertension the increased peripheral resistance may lead to narrowing of small arteries and arterioles resulting in the cardiovascular diseases. Anti- hypertensive therapy seeks to prevent the complications of high blood pressure and related CVD through its wide range of drugs such as ACE inhibitors, Angiotensin-II receptor antagonists, beta blockers etc. and so there is an exigency to study and understand their choice, usage, safety and efficacy as choice drugs in the treatment of various cardiovascular disorders[3].The excess strain and the damage from hypertension results in deposition of fat, cholesterol and other substances which are together called as plaque thereby causing the blockage of coronary artery, which is responsible for the supply of blood to the heart starving the muscle from oxygen and nutrients. Heart muscle death that occurs is called as Myocardial infarction or Heart attack[4]. High blood pressure develops coronary artery disease in many people because of the added force against the artery walls. This extra pressure results in atherosclerosis [5]. Hypertension causes fibrosis, dilation and structural changes in the shape of the left ventricle to spherical from elliptical. This condition is called Heart failure [6]. Due to overloading of ventricle, there will be reduced force of contraction in a person with heart failure [7]. Beta blockers shows their mechanism by decreasing or inhibiting the sympathetic nervous system effects thereby decreasing the epinephrine which stimulates the beta-1 receptor in the heart responsible for the myocardial contraction[8].Angiotensin converting enzyme inhibitors shows their mechanism of reducing the high blood pressure by inhibiting the conversion of angiotensin I to angiotensin II which induces the vasoconstriction [9]. Angiotensin II receptor blockers works by blocking the angiotensin receptors to which the angiotensin II binds and causes increase in blood pressure by constricting blood vessels[10].

This study is proposed for understanding and determining the selected Categories of Anti - hypertensive drugs which include ACE inhibitors, Angiotensin-II receptor antagonists, beta blockers given for treating various hypertension conditions in selected types of cardiovascular diseases such as Heart failure, Myocardial infarction, coronary artery disease. This study helps in the identification of the drugs whichcan be safe and effective among the selectiveAnti-Hypertensive drugs as well as against each Selective Cardiovascular disease.

2. AIM

To determine the safety and efficacy of the Anti-Hypertensive Drugs in treating Hypertension conditions among patients of cardiovascular diseases.

3. OBJECTIVES

- To assess the parameters of systolic and diastolic pressures in CVD patients with Hypertension before and after taking the prescribed selective categories of Anti-Hypertensive Drugs (ACE inhibitors, Angiotensin-II receptor antagonists, beta blockers).
- To determine the efficacy rate of Anti-hypertensive drugs among the selective categories in selective CVD patients (Myocardial Infarction, Heart Failure, Coronary Artery Disease).
- To identify the side effects of the selective prescribed Anti-hypertensive drugs with other prescribed drugs in selective CVD patients with hypertension.

4. METHODOLOGY

This observational study was done to identify the Anti-hypertensive drug with utmost benefits with less side effects. This study was done among 220 patients with cardiovascular disease who had been admitted as Inpatients in the selected tertiary care hospital. In this study, we have selected three cardiovascular diseases which include myocardial infarction, coronary artery disease, heart failure with hypertension. Among 220 sample size,100 were myocardial infarction patients,100 were coronary artery disease patients and 20 were heart failure patients. The BP parameters were recorded initially at the time of patient's admission followed by the day one of the treatment and for three days on daily basis and obtained the data of four days.

4.1 Sampling Procedure

This study sample consist of hypertensive patients with selected cardiovascular disease reporting to Inpatient department of selected tertiary care hospital.

4.2 First Study Sitting

On the First visit, demographic details, personal history, past medical history, past Medication history, diagnosis and the vital signs such as blood pressure and the treatment drugs were recorded.

4.3 Second Study Sitting

Patient blood pressure, pulse rate was examined. These values were compared with the previous values. The mean of the systolic and diastolic pressure values were calculated.

4.4 Inclusion Criteria

- ❖ All CVD Patients of age group >25 years.
- ❖ CVD patients with Hypertension.

4.5 Exclusion Criteria

- Patients who are not willing to join the study.
- Patients who are pregnant and lactating women.

4.6 Sample Size

Sample size was 220 and was determined based on the availability of the data regarding the study and the time period of the study.

4.7 Data Collection, Management and Analysis Methods

- Data is collected from all the CVD patients with hypertension who were visiting the cardiology department of the study site.
- Data is collected by using specially designed patient data collection forms (Patient Demographic characteristics proforma), (Patient consent form in telugu), (Patient consent form in English).

4.7.1 Data management

All the demographic details and the measurement of blood pressure values were collected in excel sheet.

4.7.2 Statistical methods

Mean calculation was done for the systolic pressure values and the diastolic pressure values for four frequencies after the treatment with anti-hypertensive drug.

5. RESULTS

The parameters of normal Systolic/Diastolic pressures, normal Systolic Pressure, normal Diastolic Pressure, abnormal Systolic/Diastolic Pressures. These were the inferences of the BP parameters taken after the patient had received the treatment. The Efficacy rate was measured based on the number of patients observed with normal systolic and diastolic pressures after the treatment designated as the first parameter in the table.

The efficacy rate of Telmisartan was 83.33% and was observed to be greater than the efficacy rate of Olmesartan which was 16.66% in Myocardial Infarction patients.

The efficacy rate of was 93.1% and was observed to be greater than the efficacy rate of Carvedilol which was 6.89%.

The efficacy rate of Ramipril was 50% and the efficacy rate of Lisinopril was 50% and these values were observed to be equal.

The efficacy rate of Telmisartan was 83.33% and was observed to be greater than the efficacy rate of Olmesartan which was 16.66% in coronary artery disease patients.

The efficacy rate of was 93.1% and was observed to be greater than the efficacy rate of Carvedilol which was 6.89%.

The efficacy rate of Ramipril was 50% and the efficacy rate of Lisinopril was 50% and these values were observed to be equal.

The efficacy rate of Telmisartan was 75% and was observed to be greater than the efficacy rate of Olmesartan which was 25%.

The efficacy rate of Lisinopril was 66.6% and was observed to be greater than the efficacy rate of Ramipril which was 33.3%.

The efficacy rate of Metoprolol was 75% and was observed to be greater than the efficacy rate of Carvedilol which was 25%.

Table 1. Efficacy of Angiotensin-II Receptor Blockers in Myocardial Infarction patients

Inference	Telmisartan (No. of Patients)	Olmesartan (No. of Patients)	Total	Percentage (%)
SP/DP Normal	5	1	6	19.35
SP Normal	3	0	3	9.67
DP Normal	11	5	16	51.61
SP/DP Abnormal	6	0	6	19.35
Total	**25**	**6**	**N=31**	**100**

**SP-Systolic Pressure, *DP-Diastolic Pressure*

Note: The SP/DP values are the mean of three observations of different time intervals with 24 hrs each

Table 2. Efficacy of Beta Blockers in Myocardial Infarction Patients

Inference	Metoprolol (No. of Patients)	Carvedilol (No. of Patients)	Total	Percentage (%)
SP/DP Normal	27	1	28	48.27
SP Normal	8	1	9	15.51
DP Normal	13	2	15	25.86
SP/DP Abnormal	5	1	6	10.34
Total	53	5	N=58	100

**SP-Systolic Pressure, *DP-Diastolic Pressure*

Note: The SP/DP values are the mean of three observations of different time intervals with 24 hrs each

Table 3. Efficacy of Angiotensin Converting Enzyme Inhibitors in Myocardial Infarction Patients

Inference	Ramipril (No. of Patients)	Lisinopril (No. of Patients)	Total	Percentage(%)
SP/DP Normal	2	2	4	40
SP Normal	0	1	1	10
DP Normal	1	2	3	30
SP/DP Abnormal	2	0	2	20
Total	**5**	**5**	**N=10**	**100**

**SP-Systolic Pressure, *DP-Diastolic Pressure*

Note: The SP/DP values are the mean of three observations of different time intervals with 24 hrs each

Table 4. Efficacy of Angiotensin-II Receptor Blockers Coronary Artery Disease Patients

Inference	Telmisartan (No. of Patients)	Olmesartan (No. of Patients)	Total	Percentage(%)
SP/DP Normal	5	1	6	19.35
SP Normal	3	0	3	9.67
DP Normal	11	5	16	51.61
SP/DP Abnormal	6	0	6	19.35
Total	**25**	**6**	**N=31**	**100**

**SP-Systolic Pressure, *DP-Diastolic Pressure*

Note: The SP/DP values are the mean of three observations of different time intervals with 24 hrs each

Table5. Efficacy of Beta Blockers in Coronary Artery Disease Patients

Inference	Metoprolol (No. of Patients)	Carvedilol (No. of Patients)	Total	Percentage(%)
SP/DP Normal	27	1	28	48.27
SP Normal	8	1	9	15.51
DP Normal	13	2	15	25.86
SP/DP Abnormal	5	1	6	10.34
Total	**53**	**5**	**N=58**	**100**

**SP-Systolic Pressure, *DP-Diastolic Pressure*

Note: The SP/DP values are the mean of three observations of different time intervals with 24 hrs each

Table 6. Efficacy of Angiotensin Converting Enzyme Inhibitors in Coronary Artery Disease Patients

Inference	Ramipril (No. of Patients)	Lisinopril (No. of Patients)	Total	Percentage(%)
SP/DP Normal	2	2	4	40
SP Normal	0	1	1	10
DP Normal	1	2	3	30
SP/DP Abnormal	2	0	2	20
Total	**5**	**5**	**N=10**	**100**

**SP-Systolic Pressure, *DP-Diastolic Pressure*

Note: The SP/DP values are the mean of three observations of different time intervals with 24 hrs each

Table 7. Efficacy of Angiotensin-II Receptor Blockers in Heart Failure Patients

Inference	Telmisartan (No. of Patients)	Olmesartan (No. of Patients)	Total	Percentage(%)
SP/DP Normal	3	1	4	50
SP Normal	1	0	1	12.5
DP Normal	2	0	2	25
SP/DP Abnormal	0	1	1	12.5
Total	**6**	**2**	**N=8**	**100**

**SP-Systolic Pressure *DP-Diastolic Pressure*

Note: The SP/DP values are the mean of three observations of different time intervals with 24 hrs each

Table 8. Efficacy of Beta Blockers in Heart Failure Patients

Inference	Metoprolol (No. of Patients)	Carvedilol (No. of Patients)	Total	Percentage(%)
SP/DP Normal	3	1	4	57.14
SP Normal	0	0	0	0
DP Normal	0	1	1	14.28
SP/DP Abnormal	2	0	2	28.57
Total	**5**	**2**	**N=7**	**100**

**SP-Systolic Pressure, *DP-Diastolic Pressure*

Note: The SP/DP values are the mean of three observations of different time intervals with 24 hrs each

Table 9. Efficacy of Angiotensin Converting Enzyme Inhibitors in Heart Failure Patients

Inference	Ramipril (No. of Patients)	Lisinopril (No. of Patients)	Total	Percentage(%)
SP/DP Normal	1	2	3	60
SP Normal	0	0	0	0
DP Normal	1	0	1	20
SP/DP Abnormal	1	0	1	20
Total	**3**	**2**	**N=5**	**100**

**SP-Systolic Pressure *DP-Diastolic Pressure*

Note: The SP/DP values are the mean of three observations of different time intervals with 24 hrs each

Table 10. Side Effects of Selective Anti-Hypertensive Drugs

Anti-Hypertensive Drugs	Cough	Drowsiness	Hypotension	Headache
Telmisartan	2	0	1	1
Olmesartan	3	2	1	2
Metoprolol	0	2	0	0
Carvedilol	2	3	1	2
Ramipril	1	2	1	1
Lisinopril	2	4	2	3

5.1 Safety Profile of Selective Anti-Hypertensive Drugs

Among the prescribed drugs, it has been observed that Metoprolol resulted in least side effects with drowsiness among two patients followed by which Telmisartan resulted without drowsiness among any patient but with cough in two patients, hypotension in one patient and head ache in one patient. The other prescribed drugs caused the side effects such as cough, drowsiness, hypotension and headache. However, all side effects caused by all prescribed drugs were found to be manageable.

6. DISCUSSION

Among 100 Myocardial Infarction patients, 31 patients were prescribed with Angiotensin-II Receptor Blockers. The drug Telmisartan was prescribed to about 25 patients and Olmesartan was prescribed to about 6 patients. Telmisartan

was observed to be more prescribed and effective than Olmesartan in normalizing the SP/DP levels within four days and the efficacy of the later was slow in Myocardial Infarction patients. These ARB's were effective normalizing Diastolic Pressure as the overall patient count who have normal DP value after treatment were high. Among 100 Myocardial Infarction patients,58 patients were prescribed with Beta Blockers. The drug Metoprolol was prescribed to about 53 patients and Carvedilol was prescribed to 6 patients. The Efficacy rate of Metoprolol was observed to be 93.1% and the efficacy rate of Carvedilol was observed to be 6.89%. Metoprolol was observed to be more prescribed and effective than Carvedilol in normalizing the SP/DP values within four days and the efficacy of the later was slow in Myocardial Infarction Patients. Among the 100 Myocardial Infarction patients,10 patients were prescribed with Angiotensin Converting Enzyme Inhibitors. Among 10 patients, the drug Ramipril was prescribed to 5 patients and the drug Lisinopril was prescribed to 5 patients. The Efficacy rate among these two drugs was observed as Ramipril-50% and Lisinopril-50%. The two drugs were observed to be equally prescribed and effective in normalizing the SP/DP values within four days in Myocardial Infarction patients.

Among 100 coronary artery disease patients, 31 patients were prescribed with Angiotensin-II Receptor Blockers. The drug Telmisartan was prescribed to about 25 patients and Olmesartan was prescribed to about 6 patients. The Efficacy rate of Telmisartan was observed to be 83.33% and Olmesartan was observed as 16.66%. Telmisartan was observed to be more prescribed and effective than Olmesartan in normalizing the SP/DP levels within four days and the efficacy of the later was slow in coronary artery disease patients. These ARB's were effective normalizing Diastolic Pressure as the overall patient count who have normal DP value after treatment were high. Among 100 coronary artery disease patients,58 patients were prescribed with Beta Blockers. The drug Metoprolol was prescribed to about 53 patients and Carvedilol was prescribed to 6 patients. The Efficacy rate of Metoprolol was observed to be 93.1% and the efficacy rate of Carvedilol was observed to be 6.89%. Metoprolol was observed to be more prescribed and effective than Carvedilol in normalizing the SP/DP values within four days and the efficacy of the later was slow in coronary artery disease Patients. Among the 100 Myocardial Infarction patients,10 patients were prescribed with Angiotensin Converting Enzyme Inhibitors. Among 10 patients, the drug Ramipril was prescribed to 5 patients and the drug Lisinopril was prescribed to 5 patients. The Efficacy rate among these two drugs was observed as Ramipril-50% and Lisinopril-50%. The two drugs were observed to be equally prescribed and effective in normalizing the SP/DP values within four days in coronary artery disease patients.

Among 20 patients,8 patients were prescribed with Angiotensin-II Receptor Blockers. The drug Telmisartan was prescribed to about 6 patients and Olmesartan was prescribed to about 2 patients. The Efficacy rate of Telmisartan was observed to be 75% and Olmesartan was observed as 25%. Telmisartan was observed to be more prescribed and effective than Olmesartan in normalizing the SP/DP levels within four days and the efficacy of the later was slow in Heart Failure patients. Among 20 Heart Failure patients,7 patients were prescribed with Beta Blockers. Among 7 patients, the drug Metoprolol was prescribed to about 5 patients and Carvedilol was prescribed to 2 patients. The Efficacy rate among these drugs was distributed as Metoprolol-75% and Carvedilol-25%. Metoprolol was observed to be more prescribed and effective than Carvedilol in normalizing the SP/DP values within four days and the efficacy of the later was slow in Heart Failure Patients. Among 20 Heart Failure patients,5 patients were prescribed with Angiotensin Converting Enzyme Inhibitors. Among 5 patients, the drug Ramipril was prescribed to about 3 patients and the drug Lisinopril to about 2 patients. The Efficacy rate among these two drugs was distributed as Ramipril-33.3% and Lisinopril-66.6%. These observations show that the drug Ramipril was prescribed to more No. of patients but the drug Lisinopril has shown more efficacy in Heart Failure patients. Ramipril was observed to be more prescribed than Lisinopril but Lisinopril was observed to be more effective than Ramipril in normalizing the SP/DP levels within four days and the efficacy of the later was slow in Heart Failure patients.

Side effects were less severe, they subsided after the elimination of the drug out of the body. For the patients experienced hypotension, Intravenous fluids were prescribed as a remedy. The patients who have experienced the side effect of drowsiness were suggested not to go anywhere else without the presence of patient representative. The Patients with the side effect

of cough were suggested to drink water to avoid dryness of mouth.

7. CONCLUSION

In our study, we conclude that among the study sample of 220 patients, 100 patients were observed as diagnosed with Myocardial Infarction which revealed the prevalence of 45.4% among the total. Among the study samples of 220 patients,100 patients were observed with coronary artery disease which revealed the prevalence of 45.4% among the total. Among the study samples of 220 patients,20 patients were observed with Heart Failure which revealed the prevalence of 9.2% among the total. Patients with abnormal pulse rate were prescribed Beta blockers for hypertension and the patients with normal pulse rate were prescribed ACE Inhibitors and ARB's. In Myocardial Infarction patients, among Angiotensin-II Receptor Blockers, telmisartan was observed to be more effective than Olmesartan. Among Beta Blockers, metoprolol was observed to be more effective than Carvedilol. Among Angiotensin Converting Enzyme Inhibitors, ramipril and lisinopril were observed to be equally effective. In Coronary Artery Disease patients, among Angiotensin-II Receptor Blockers, Telmisartan was observed to be more effective than Olmesartan. Among Beta blockers, metoprolol was observed to be more effective than Carvedilol. Among Angiotensin Converting Enzyme Inhibitors, Ramipril and Lisinopril were observed to be equally effective. In Heart Failure patients, among Angiotensin-II Receptorblockers, telmisartan was observed to be more effective than Olmesartan. Among Beta Blockers, metoprolol was observed to be more effective than Carvedilol. Among Angiotensin Converting Enzyme Inhibitors, lisinopril were observed to be equally effective than ramipril. In this study, Metoprolol was observed to be the safer drug with less side effects.

While comparing all the three categories of Anti-Hypertensive drugs, Beta Blockers were observed to be the drugs with maximum benefits and had shown better efficacy by optimal therapy.

CONSENT

Informed consent was obtained from the participants.

ETHICAL APPROVAL

Institutional Review Board has approved for further research. The ethical committee considered protocol revisions and the IRB board completed a review. The Ethical Committee has reviewed and approved without any changes.

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COMPETING INTERESTS

We declared no conflict of interest because all of the authors contributed equally to the start of the research and have not highlighted any conflict of interest regarding their responsibilities.

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