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A Research Article on Effect of ACE Inhibitors on C- Reactive Protein Inpatients with Hypertension

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Lincy Joseph[1], Mathew George[2], Riswana.R[2*]

[1]Department of Pharmaceutical Chemistry, Pushpagiri College of Pharmacy, Thiruvalla -689107, Kerala, India

[2]Department of Pharmacology, Pushpagiri College of Pharmacy, Thiruvalla - 689107, Kerala, India

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ABSTRACT

The objective of this study to determine the effect of ACE inhibitors on C-reactive protein (CRP) in patients with hypertension. The ACE inhibitors used in this study are ramipril and enalapril.Total 60 patients were selected based on inclusion and exclusion criteria. Patients treated with ramipril 2.5,5.or 10 and enalapril 5.10 or 20 and the effect of CRP levels analysed on the day of admission, after 24 hr and at discharge by using semi auto analyser. In this study concluded that ramipril has more effectively decrease CRP levels than enalapril.

INTRODUCTION

Blood pressure is the force exerted by the blood against the walls of blood vessels, and the magnitude of this force depends on the cardiac output and the resistance of the blood vessels.

Hypertension is defined as having a blood pressure higher than 140 over 90 mmHg, with a consensus across medical guidelines. This means the systolic reading (the pressure as the heart pumps blood around the body) is over 140 mmHg (millimeters of mercury) and/or the diastolic reading (as the heart relaxes and refills with blood) is over 90 mmHg.

This threshold has been set to define hypertension for clinical convenience as patients experience benefits once they bring their blood pressure below this level.
However, medical experts consider high blood pressure as having a continuous relationship to cardiovascular health. They believe that, to a point, the lower the blood pressure the better (down to levels of 115-110 mmHg systolic, and 75-70 mmHg diastolic). the lower the blood pressure the better.

This view has led the American Heart Association (AHA), for example, to define the following ranges of blood pressure (in mmHg):

- Normal blood pressure is below **120 mmHg** systolic and below **80 mmHg** diastolic
- Prehypertension is **120-139 mmHg** systolic or **80-89 mmHg** diastolic
- Stage 1 high blood pressure (hypertension) is **140-159 mmHg** systolic or **90-99 mmHg** diastolic
- Stage 2 high blood pressure (hypertension) is **160 mmHg** or higher systolic or **100 mmHg** or higher diastolic

Hypertensive crisis (a medical emergency) is when blood pressure is above 180 mmHg systolic or above 110mHg diastolic. Angiotensin-converting enzyme (ACE) inhibitors are agents used to relax blood vessels and lower blood pressure. They prevent an enzyme from producing angiotensin II, which narrows blood vessels and raises blood pressure, meaning the heart has to work harder to pump blood around the body.

ACE inhibitors are prescribed to treat or prevent symptoms in conditions such as coronary artery disease, hypertension, kidney disease, heart attack, heart failure and migraines. These drugs may

be prescribed in combination with other antihypertensive drugs such as diuretics or calcium channel blockers and they are usually taken once a day, in the morning.

ACE inhibitors work by decreasing the activity of the renin-angiotensin-aldosterone system (RAAS). The RAAS is a complex physiological system that controls fluctuations in blood pressure. A protein called renin is released by the juxtaglomerular apparatus in the kidneys. Renin then produces angiotensin, the active form of which stimulates the adrenal gland to produce a hormone called aldosterone. Aldosterone stimulates the reabsorption of water and conservation of sodium, therefore increasing water retention and blood pressure.

ACE inhibitors have an increasing role in the management of cardiovascular risk. Examples of these drugs include enalapril, captopril, fosinopril, perindopril, lisinopril, ramipril and quinapril. The reduction in blood pressure that follows ACE inhibition is greatest after stimulation of the RAAS system due to diuretic therapy, for example, but these agents can also reduce blood pressure activity when RAAS activity is low or normal. However, people with low renin hypertension such as elderly people or Afro-Caribbeans tend to be less responsive to ACE inhibitor therapies.

C-reactive protein (CRP), the prototypical acute-phase reactant, is one of the most widely known biomarkers of cardiovascular disease. Circulating levels of CRP are clinically used to predict the occurrence of cardiovascular events and to aid in the selection of therapies based on more accurate risk assessment in individuals who are at intermediate risk. various paper reviews the role of CRP in hypertension. In hypertensive individuals, CRP levels associate with vascular stiffness, atherosclerosis and the development of end-organ damage and cardiovascular events. Data suggest that some anti-hypertensive medications may lower CRP levels in a manner independent of their effect on blood pressure. In individuals who are normotensive at baseline, CRP levels have been shown in multiple cohorts to foretell the development of hypertension on follow-up. Whether genetic variability that influences circulating levels of CRP independent of environmental and behavioral factors can also be used in a similar manner to predict the change in blood pressure and development of hypertension is controversial. In addition to its role as a biomarker, experimental studies have unraveled an active direct participation of CRP in the development of endothelial dysfunction, vascular stiffness, and elevated blood pressure. CRP has

also been implicated as a mediator of vascular remodeling in response to injury and cardiac remodeling in response to pressure overload.

MATERIALS AND METHODS

This is a prospective experimental study conducted in 60 IP patients primarily diagnosed with hypertension in Pushpagiri Medical College Hospital, Thiruvalla. The patients were selected based on the inclusion and exclusion criteria. Inclusion criteria were patients primarily diagnosed with hypertension, patients having age above 30, both male and female patients, IP patients. Exclusion criteria were arthritis patients, diabetic patients, cancer patients, lactating women and pregnant ladies, those taking anti-inflammatory agents. The ACE inhibitors used in this study are ramipril and enalapril. The patients were randomized to receive ramipril 2.5, 5 or 10 mg and enalapril 5, 10 or 20 mg. The study population was divided into two groups based on the administering drug. 30 patients were selected who were being administered with ramipril and 30 patients who were given enalapril. The patient's data were collected based on demographic details, social and dietary history, BMI, and ADR caused by the ACE inhibitor drug given. Data collection forms were supplied, patient counselling and leaflets were handed over to the selected patients. The C-reactive protein and BP of patients were determined on admission, after 24 hours, and at discharge. The CRP levels were estimated by semi auto analyser using chemical reagents. After data collection, it was analysed using SPSS software. The results based on the effectiveness of ACE inhibitors and which drug proved to reduce the elevated CRP levels more were evaluated and document.

STATISTICAL ANALYSIS

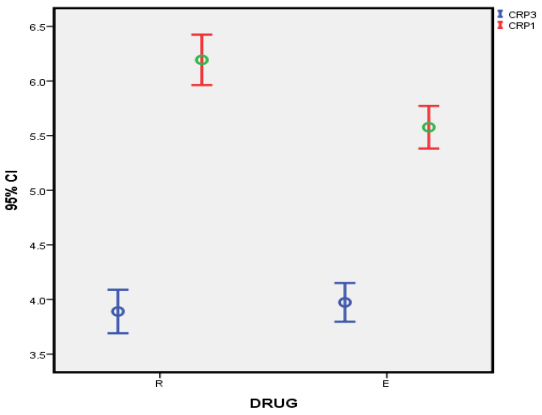
All statistical analyses were performed using SPSS software. Mean and standard deviation were used for the variables of the study. To determine the effect of ACE inhibitors on CRP in patients with hypertension by using a various test like ANOVA, chi-square test were used. The significant association between the variables under consideration were found out if the p-value is less than 0.05.

RESULTS AND DISCUSSION

The ACE inhibitors used in this study are ramipril and enalapril. The patients were randomized to receive ramipril 2.5, 5 or 10 mg and enalapril 5, 10 or 20 mg. The study population was divided into two groups based on the administering drug. 30 patients were selected who were being administered with ramipril and 30 patients who were given enalapril. The compare effect on CRP of ramipril and enalapril analysed based on the different variables such as age, BMI, social, and diet habits. The main objective of this study was the effect of ACE inhibitors on C-reactive protein levels, the result of this based on the statistical analysis is significant ($p<0.05$) table1, graph1. on the basis of the comparative effect of ramipril and enalapril, ramipril is more reduced C- reactive protein levels than enalapril. (table2, graph2). B based upon the demographic details such as age (above 30), sex, (F=44, M=16) this study has no more variations, but the social and diet habits play an important role in the elevation of C-reactive protein levels, smokers have elevated CRP levels than non-smokers. According to the BMI the normal patients have more reduced CRP than obese patients. The adverse reaction of ACE inhibitors categorised into dizziness,(7) cough, (12) hyperkalemia, (11) nil (30). In this study, the adverse drug reaction is more seen in ramipril talking patients than patients treated with enalapril (table3,graph3).

Table.1 showing the effect of ACE inhibitors on c reactive protein levels.

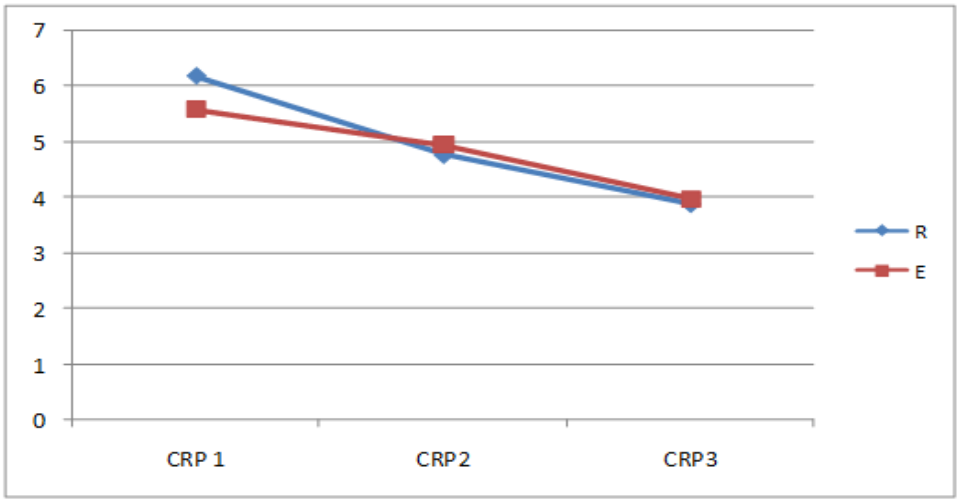
DRUG		CRP1	CRP3
R	Mean	6.19	3.89
	N	30	30
	Std. Deviation	.618	.533
E	Mean	5.58	3.97
	N	30	30
	Std. Deviation	.522	.474
Total	Mean``	5.89	3.93
	N	60	60
	Std. Deviation	.647	.502



Graph. 1 showing the effect of ACE inhibitors on c reactive protein levels.

Table. 2 showing the result of the comparative effect of ACE inhibitors (ramipril & enalapril)

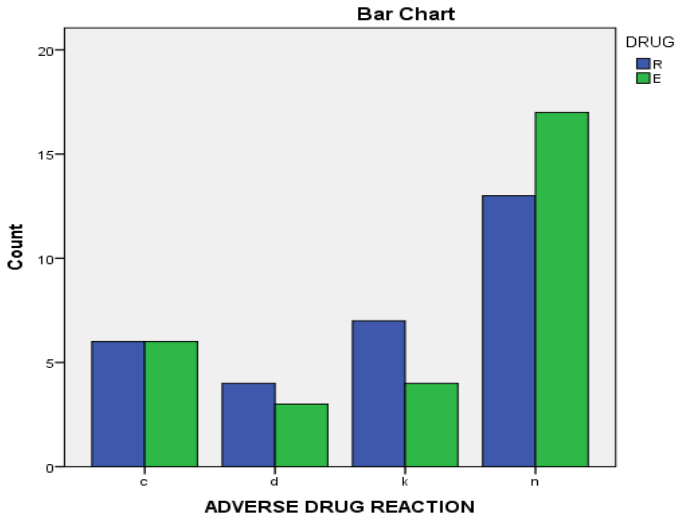
Group Statistics					
	DRUG	N	Mean	Std. Deviation	Std. Error Mean
CRP1	R	30	6.19	.618	.113
	E	30	5.58	.522	.095
CRP2	R	30	4.77	.538	.098
	E	30	4.94	.619	.113
CRP3	R	30	3.89	.533	.097
	E	30	3.97	.474	.087



Graph. 2 showing the results of comparative effect of ACE inhibitors (ramipril & enalapril).

Table. 3 Showing the results adverse effects of ACE inhibitors (ramipril & enalapril)

ADVERSE DRUG REACTION * DRUG Cross tabulation					
			DRUG		Total
			R	E	
ADVERSE DRUG REACTION	c	Count	6	6	12
		% of Total	10.0%	10.0%	20.0%
	d	Count	4	3	7
		% of Total	6.7%	5.0%	11.7%
	k	Count	7	4	11
		% of Total	11.7%	6.7%	18.3%
	n	Count	13	17	30
		% of Total	21.7%	28.3%	50.0%
Total		Count	30	30	60



Graph. 3 Showing the results adverse effects of ACE inhibitors (ramipril & enalapril)

CONCLUSION

In this study concluded that anti-inflammatory agent as well as antihypertensive agents, ramipril and enalapril has the effect of reducing C-reactive protein levels in human serum. Total 60 patients participated in this study. In this study also determined the ramipril has more effectively reduced C-reactive protein than enalapril. The blood pressure of the patients also reduced both drugs effectively. The social and diet habits play an important role in the elevation of C-reactive protein levels, smokers have elevated CRP levels than non-smokers. According to the BMI the normal patients have more reduced CRP than obese patients. The adverse reaction of ACE inhibitors categorised into dizziness,(7) cough,(12) hyperkalemia,(11) nil (30). In this study, the adverse drug reaction is more seen in ramipril talking patients than patients treated with enalapril.

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