

RENAL ORGAN DAMAGE IN ESSENTIAL HYPERTENSION , IN RURAL POPULATION OF MARWAR REGION OF RAJASTHAN.

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Introduction

An elevated blood pressure is probably the most important public health problem in developed and developing countries as well. It is common, asymptomatic, readily detectable and usually easily treatable and if untreated often lead to lethal complication¹. Blood pressure is considered to be a continuously distributed variable and essential hypertension is one extreme of this distribution².

Hypertension is a multifactorial disease with interaction of multiple environmental and gene determinants, is a condition with its own risk factor and determinants. Hypertension is threat to life at all age in both sexes with its grave impact in the aged, in the young: male as well as female. The number of patients with hypertension is continuous to grow as longevity increase and it is estimated that one half of peoples older than 65 years are hypertensive⁵.

Mild to moderate elevation of hypertension of blood pressure is well known to have a damaging effect on arterial vasculature specially small sized arteries as well as arterioles. The relation between arterial pressure and morbidity and mortality is quantitative so that higher the pressure, the worse the prognosis because primary target organ in hypertension is arterial system and untreated hypertension can lead to serious consequences in several organs such as heart, kidney, brain, eyes⁶.

The effect of hypertension on the organ known as target organ damage and it is important to identify early lesion in these organs, which gives sound information about the duration of high BP, may precisely predict the long term prognosis⁹.

Increased urinary albumin excretion is found in hypertensive patient, is associated with renal dysfunction or target organ damage in these patient .Microalbuminuria may indicate target organ damage in hypertensive patient, evidence suggest important relationship among chronic micro-inflammatory process. Endothelial dysfunction, hypertension and microalbuminuria process¹⁴.

Signs of target organ damage often heralds a poorer prognosis, may present in heart, kidney etc. Later consequences include cardiac, renal, cerebrovascular morbidities and mortalities .In clinical practical it is very difficult to establish an accurate duration of hypertensive condition.

It is important to identify the early lesion in these organs in order to reduce the mortality and morbidity.

There is no study from this region which indicates the magnitude of target organ damage at community level.

So there is need to carry out a community base study to determine the target organ damage due to hypertension.

Aim & Objectives

1. To determine the magnitude of renal damage as target organ damage in the patient of hypertension in rural area of desert region of Rajasthan.
2. To recommend intervention programme to prevent target organ damage in patient of hypertension.

MATERIAL AND METHODS

The present study was a cross-sectional community based survey, conducted at Gundoj village of Pali District of western Rajasthan with a population of 10,000 peoples approximately.

The household member of selected population aged 20 years and above constituted the study population.

The Gundoj village of Pali district of Rajasthan was selected for present study.

A total of 200 subjects of 20 years and above were selected from the study area. Out of which 100 were hypertensive subjects and 100 age, sex matched non-hypertensive subject were selected for this study.

All the subjects were interviewed and examined for:

1. Demographic profile
2. Complete present, past, occupational, family and social history.
3. Complete general physical examination including height and weight
4. Systemic clinical examination
5. Following laboratory investigation were performed
 1. Blood pressure measurement
 2. Biochemical : b. sugar, serum creatinine and urinary protein
 3. Standard 12 leads electrocardiography

Diagnosis of hypertension

Hypertension was defined as either as SBP > 140 mmHg and/or DBP >90 mmHg and/or treatment with any anti-hypersensitive medication.

The guidelines of Joint National Committee on prevention, detection and treatment of High blood pressure(JNC VIII)was taken.

inclusion criteria

1. Blood pressure reading > 140/90mmHg.
2. Subjects taking antihypertensive treatment.
3. Diagnosed previously but not taking treatment at time of survey.

Exclusion criteria

patient < 20 years of age patients with kidney disease such as bilateral renal artery stenosis, renal parenchymal disease or CRF, patients with kidney stone, ureteric obstruction, prostatic hypertrophy or any obstructive uropathy and UTI.

Patient with endocrine disorder e.g. Pheochromocytoma, Cushing syndrome, diabetes mellitus, Acromegaly, thyroid disorder like hyperthyroidism or hypothyroidism

1. Person on oral contraceptives
2. Neurogenic and psychiatric disorder
3. Drugs which known to cause hypertension like steroids.
4. Fever, porphyria's
- 5.Pregnancy

Collection of samples

1. Blood: Blood sample obtained for blood sugar and serum creatinine and analyzed by using RA-50 Analyzer.

2. Urine sample: First morning mid-stream sample will be collected with aseptic measures for urine analysis like albumin measurement, urine sugar.

Following criteria are used for assessment of renal damage

1. Serum creatinine - reference value < 1.5 mg/dl
2. Urinary protein analysis of urinary albumin by using dip sticks which is sensitive to measure the urinary albumin < 300 mg/d
3. Creatinine clearance reference value 91-130 ml/min. By using Cock-Goult formula creatinine clearance will be measured as follows Creatinine clearance =

$(140 - \text{age}) \times \text{body wt. (kg)} / \text{Serum creatinine (mg/dl)} \times 72$

Value should be adjusted for 1.73 m body surface area Value should be multiplied by 0.85 for woman

Statistical Method: The data were entered in Excel sheet and analyzed by using Epi-Info software. The chi-square and student's 't' test was applied to find significant relationship between two variables.

A total of 200 individuals were included in study. Out of which 100 were hypertensive and 100 age and sex match normotensive were taken as control. Both normotensive and hypertensive were further divided in three groups according to age.

First group included 20 individuals in each group of age of 20-40 yrs (younger group). Second group hold 60 individuals in each group, of aged 41-60yrs (middle age group). In third group 20 individuals of aged 61yrs and above (older age group) included each in normotensive and hypertensive.

Majority of individuals were belonging to 40-60yrs (middle age group, 60%) followed by 20% each from 20-40 yrs and 61 yrs and above age group.

BP classification	SBP mmHg	DBP mmHg
normal	<120	<80
prehypertension	120-139	80-89
Stage 1 hypertension	140-159	90-100
Stage 2 hypertension	160 and above	>100

2. Age, sex and percentage wise distribution of hypertensive individuals according to isolated systolic and isolated diastolic blood pressure.

Average 31% hypertensives shown isolated SBP and 6% hypertensive individuals shown isolated DBP which was statistically significant ($p < 0.05$).

Isolated SBP increased with increasing age while no definite trend has been observed in isolated DBP. Females had more isolated SBP as compared to males but it was statistically not significant ($p > 0.05$).

Table 1

Age Group	Normotensive			Hypertensive			Grand Total		
	male	Female s	Total	Males	Females	Total	Males	Female s	Total
20-40	10 17.9%	10 22.7%	20 20%	10 18.2%	10 22.2%	20 20%	20 18.1%	20 22.5%	40 20%
41-60	33 58.9%	27 61.4%	60 60%	32 58.2%	28 62.2%	60 60%	65 58.5%	55 61.7%	120 60%
60+	13 23.2%	7 15.6%	20 20%	13 23.6%	7 15.6%	20 20%	26 23.4%	14 15.8%	40 20%
total	56 100%	44 100%	100 100%	55 100%	45 100%	100 100%	111 100%	89 100%	200 100%

Table 2

S Stolic Blood Pressure \pm SDmmH		Diastolic Blood Pressure \pm SDmmH	
Normotensive	Hypertensive	Normotensive	Hypertensive
126.7 \pm 9.5	148.3 \pm 27,3	81.9 \pm 7.3	91.5 \pm 1 1.8
121.6 \pm 9.9	150.9 \pm 20.2	74.3 \pm 6.6	92.1 \pm 1 1.3
123.1 \pm 9.9	161.8 \pm 37.6	72.0 \pm 7.7	88.0 \pm 11.6
123.8 \pm 9.7	153.7 \pm 28.4	76.1 \pm 7.9	90.5 \pm 1 1.6

3. age and sex wise distribution of hypertensive individuals according to duration of hypertension.

Among males, the average duration of hypertension was 7.3 ± 4.6 yrs while in females, it was 9.3 ± 6.5 yrs. Out of 33 known male hypertensives, 10 (30.3%) had <4yrs duration, 10(30.3%) were of 5-9 Yrs duration and remaining 13(39.4%) had duration of 10yrs and above. While in females; 8(36.4%), and 8 (36.3%) had <4yrs, 5-9yrs and 10 yrs and above duration respectively.

Age group	N	Males		Females			Grand Total		
		Isolated SBP	Isolated DBP	N	Isolated SBP	Isolated DBP	N	Isolated SBP	Isolated DBP
20-40	10	0 0.0%	0 0.0%	10	2 20.0%	1 10.0%	20	2 10.0%	1 5.0%
40-60	32	7 21.9%	3 9.4%	28	11 39.2%	2 7.1%	60	18 30.0%	5 8.3%
61+	13	7 53.8%	0 0.0%	7	4 57.1%	0 0.0%	20	11 55.0%	0 0.0%
total	55	14 25.5%	3 5.5%	45	17 37.7%	2 4.4%	100	31 31.0%	6 6.0%

Table 3

4. Summary of Renal damage in studied population according to various predictors of target organ damage.

A total of 200 individual were selected from community on the basis of house to house survey followed by camp approach. Out of 200 individuals, 100 were hypertensives and 100 age and sex matched normotensive individuals were taken as control.

Out of 100 hypertensives 55(55%) were males and 45(45%) were females. In hypertensive subjects, the mean age of males was 52.5 ± 7.3 yrs. Where as in females, it was 52.7 ± 4.4 yrs with over all mean age of hypertensive subjects was 52.6 ± 5.8 yrs.

Likewise in 100 normotensives, 56(56%) were males and 44 (44%) were females. The mean age of males was 48.9 ± 5.6 yrs where as in females; it was 50.7 ± 4.4 yrs with overall mean age of normotensive subjects was 49.8 ± 5 yrs.

The average systolic blood pressure of normotensive population was 123.9 ± 8.6 mmHg and average SBP of hypertensive subjects was 152.8 ± 25.5 mmHg (Males= 153.7 ± 28.4 , females= 152.0 ± 22.6). The average SBP of normotensive and hypertensive subjects was significantly different ($p < 0.05$). When average SBP of normotensive and hypertensive compared in both sex it was higher in males up to age group of 20- 40yrs after which it increase more in females than males. Gupta SP⁵² et al. found the similar result that prevalence and mean blood pressure were greater in males in 3rd and 4 decade after which the trend was reversed. Nirmala et⁵³ al. also concluded that increase in blood pressure with age was sharper in females than males.

The average diastolic blood pressure of normotensive subjects was 77.1 ± 12.1 mmHg and in hypertensive subjects was 89.2 ± 10.9 mmHg (Males= 90.5 ± 11.6 , Females= 87.9 ± 10.1).

Predictor of Target organ damage	Normotensive		Known hypertensive				Unknown hypertensive	
			Controlled		Uncontrolled			
Microalbuminuria	100	11 11.0%	21	6 28.5%	34	19 55.9%	45	15 33.3%
S. creatinine > I.30mg/dl	100	18 18.00	21	10 47.1%	34	21 61.7%	45	25 55.6%
C -clearance <70ml/min	100	34 34.0%	21	7 33.3%	34	19 55.9%	45	25 55.6%
ECG-LVH	100	3	21	4 19.0%	34	11 32.3%	45	11 24.4%
Pulse pressure >60mmHg	100	8 8.0%	21	3 14.3%	34	22 64.7%	45	19 42.2%
Body mass index >25kg/m2	100	20 20.0%	21	4 19.0%	34	18 52.9%	45	12 26.7%
Waist-Hip ratio	100	11 11.0%	21	6 28.6%	34	13 38.2%	45	7 15.6%
Isolated systolic blood pressure	100	31 31.0%	21	0 0.0%	34	9 26.8%	45	20 44.4%

The average diastolic blood pressure value decrease in both sex, both in normotensive and hypertensive, with increasing age which is probably due to decrease arterial compliance with increasing age imparting low DBP value. When average diastolic blood pressure compared between male and female it was higher in males than females. Joshi PP et al.⁵⁴, Singh RB et al.⁵⁵ Hazarika NC

et al⁵⁶.also found diastolic blood pressure higher in males up to age group 20-40yrs after which it increased more in females than males in same age groups.

In this study, hypertensive population was further divided in to two categories. Those who had previous history of hypertension, irrespective of treatment and blood pressure status, categorized as known hypertensive.

Those, who had no previous history of hypertension and unaware about their blood pressure, diagnosed hypertension first time during our clinical examination categorized as unknown or undiagnosed hypertensive.

In this study there was 55% individuals were known hypertensive and 45% individuals were unknown hypertensive. Known hypertensive population comprises 60% males and 40% females while unknown hypertensive population hold 49% males and 51% females. Both in known and unknown hypertensive, difference of males and females was statistically not significant ($p>0.05$).

Naomi DL fisher, Gordon HW⁵⁷ reported the prevalence of known hypertension was 65% and unknown hypertension was 35% in their study.

JNC-7 Report states 30-40% hypertensives individuals were unaware of presence of hypertension in them even in well-developed communities Stressor T in WHO chronicle reported similar trends. This study shows slight higher prevalence of unknown hypertension (45%) this may be due to small population sample, rapid urbanization of rural population with inadequate health awareness.

In present study, in known hypertensive only 38% individuals had adequate control over blood pressure, termed controlled hypertensive. While blood pressure of 62% known hypertensive individuals were not under control, termed uncontrolled hypertensive.

Results are concordance with Joshi PP et al,⁵⁴ Singh RB et al.⁵⁵ Hazarika NC et al.⁵⁶

The average blood pressure of controlled hypertensives were $123.4 \pm 12.6 / 77.1 \pm 7.6$ mmHg and blood pressure of uncontrolled hypertensives were $172.6 \pm 20.5 / 97.4 \pm 10.1$ mmHg. Average blood pressure of unknown hypertensive was $170.3 \pm 19.4 / 96.2 \pm 9.7$ mmHg.

Two pattern of hypertension are seen in hypertensive population; combined systolic and diastolic commonly seen in younger (20-40yrs) and middle age group (41-60yrs) and isolated systolic hypertension, the more frequent form among those over the age of 60 yrs. In our study 31% hypertensive individuals showed isolated SBP while only 6% hypertensive individuals shown Isolated DBP.

There was increasing trend of isolated systolic hypertension, both in males and females, with increasing age while no definite trend observed in DBP. Similar finding observed by Norman et al⁶¹. Found isolated systolic hypertension is most common type hypertension in elderly and Willem FT et al⁶². also drawn similar observation.

In this study, in all age groups, it has been observed that total average duration of hypertension in males were 7.3 ± 4.6 yrs and in females were 9.3 ± 6.5 yrs.

Average duration of hypertension was 4.5 yrs (Males 5.5 yrs, Females 3.5 yrs) in 20-40 age group, 6.9 yrs in 40-60 yrs age group (Males 6.8 yrs, and females 7.0 yrs), 13.5 yrs in 61 yrs and above age group (Males 9.6 yrs and females 17.5 yrs).

The average duration of hypertension, both in males and females were increased with increasing age. Katsuhiko K et al.⁶³ In their study found the average duration of hypertension was 12.5 yrs in elderly (61 yrs and above), 7.5 yrs in middle aged (40-60 yrs) and 4.6 yrs in younger age (<40 yrs). Results are also concordance with Guilio S et al.⁶⁴.

High pulse pressure has recently been implicated in the development and progression of cardiovascular events in essential hypertension. In this study, it has been found that 55% hypertensives had high pulse pressure >60 mmHg as compared to 8% in normotensives which was statistically significant ($p < 0.05$). 71.0% of normotensives (males 63.4% and females 79.5%) had optimal pulse pressure (40-60 mmHg) while only 35% of hypertensives had optimal pulse pressure. 60% of male hypertensive showed pulse pressure >60 mmHg as compared to 48.9% of female hypertensives. Francesca V et al.⁶⁵. in their study, which was the part of Magic Trial, had been observed that high pulse pressure positively linked to age, male sex, hypertension and cardio-renal organ damage.

In present study, observation of BMI as a predictor of hypertension and prevalence of hypertension according to body mass index (BMI) revealed that majority of individuals, 70% normotensive (71.4% males, 68.2% females) and 59% hypertensive (63.6% males, 53.3% females) were in 18-24.99 BMI range but it was statistically not significant ($p > 0.05$).

There was 35% of hypertensives (32.8% males, 37.8 females) in >25 BMI range as compared 20% of normotensives (14.3% males, 27.3% females). It was statistically significant ($p < 0.05$).

The observation in present study agreed with previous studies like Singh RB et al.⁵⁴. Joshi PPS4, Siney C Alex et al.⁶⁶., Jajoo UN et al.⁶⁷, Bose K et al.⁶⁸. etc that a definite correlation between BMI and hypertension has been observed.

Results are in concordance with previous studies of Shanthirani et al.⁶⁹, Singh RB et al.⁵, Gani M et al., Bose K et al.⁷⁰, Pouliot MC et al.⁷¹. These studies revealed that higher BMI and increased WI-IR ratio were independently and strongly associated with hypertension in both sex.

S. creatinine is a readily available and sensitive marker of renal function and provides a quick general assessment of renal function. In this study, hypertensive individuals had higher mean S. creatinine level 1.24 ± 0.23 mg/dl as compared to 1.02 ± 0.18 mg/dl in normotensive. It was statistically significant ($p < 0.05$). S. creatinine level was higher in all age groups, both sexes, in hypertensive individuals. It was statistically significant

Males had higher mean S. creatinine level (1.30 ± 0.27 mg/dl) as compared to females (1.18 ± 0.18 mg/dl). S. creatinine level was found increased with increasing age both in normotensives

and hypertensives up to age of 60yrs then it showed declining trend in both groups. Similar results was observed by Shigematsu et al.⁷², Gosse P et al., Schillaci G et al^{73,74}. Biharac et al.⁷⁵

In present study, normotensive and hypertensive population distributed according to their S. creatinine level. Average of 56% of hypertensive individuals were found distributed towards the higher S. creatinine level (21.3mg/dl) as compared to 18% of normotensives ($p<0.05$) while 82% of normotensive individuals had S. creatinine value .3mg dl as compared to 44% of hypertensives. It was statistically significant ($p<0.03$).

More number of male hypertensives (69.1%) distributed towards higher S. creatinine value (21.3mg/dl) as compared to female hypertensives (40%). Results are concordance with previous studies.

In outpatient setting and in clinical practice, the Creatinine clearance is often used as a surrogate for GFR (glomerular filtration rate).

In this study the Creatinine clearance calculated by using Cockcroft-Gault formula. The average measured Creatinine clearance in normotensive group was 80.8 ± 16.1 ml/min/1.73m² while in hypertensive it was 59.6 ± 12.5 ml/min/1.73m. It was statistically highly significant.

When age group wise creatinine clearance compared, it was found that in all age groups the average creatinine clearance values were higher in normotensives than hypertensives. In 20-40yrs age group, the average Creatinine clearance in normotensive was 99.1 ± 19.0 ml/min. while in hypertensives, it was 72.2 ± 15.5 ml/min ($p<0.01$). In 41-60yrs age group 81.5 ± 14.3 ml/min in normotensives while 59.7 ± 12.0 ml/min in hypertensives ($p<0.05$). In 61 yrs and above age group, it was 61.7 ± 14.7 ml/min in normotensive as compared to 47.1 ± 10.1 ml/min in hypertensive ($p<0.01$).

In present study, it was observed that creatinine clearance was higher in males than females in all age groups but it was statistically not significant

Results are accorded with Leocini G et al.⁷⁷, Catena C et al.⁷⁸, Kadri S et al⁷⁹, Ozer BA et al⁸⁰, Derchi LE et al.⁸¹, Grinshtein IV et al⁸².

Various population studies of non-diabetic hypertensive individuals were demonstrated that even small amount of albumin excretion in the urine (microalbuminuria) are associated with increased risk of cardiovascular disease.

The present study aimed to assess the prevalence of microalbuminuria in hypertensive individuals. In this study, found that average 41.0% hypertensive individuals showed microalbuminuria as compared with 11.0% in normotensives. It was statistically significant ($p<0.05$). Among males a total average of 43.6% hypertensive individuals showed microalbuminuria as compared with 16.0% of normotensives. Among females, 37.8% hypertensive individuals had microalbuminuria while only 4.5% normotensive females had microalbuminuria. Higher number of males (43.6%) than females (37.8%) showed microalbuminuria but it was statistically not significant ($p>0.05$). Results are agreed with previous studies of Reboldi G et al⁸⁵. de Alvaro F et al.⁸⁶, Col M et al⁸⁷, Leocini G et al⁷⁷.

When occurrence of microalbuminuria compared with duration of hypertension in known hypertensive individuals, it has been observed that the overall prevalence of microalbuminuria increased with duration of hypertension. It was 5.6% with <4yrs duration of hypertension, 37.5% with 5-9yrs duration of hypertension and majority of hypertensive individuals (76.2%) had microalbuminuria when duration of hypertension was 10yrs and above.

Among males, the prevalence of microalbuminuria increased with duration of hypertension i.e. 10.0% with <4yrs duration, 30.0% with 5-9yrs duration and 84.6% with 10yrs and above duration of hypertension in study subjects among females.

similar pattern was observed in females with <4yrs duration, 50% with 5-9yrs duration and 62.5% with 10 yrs and above duration of hypertension but it was lower than males of study subjects. Results are in concordance with Col M et al., Cuspidi Cet al .

In present study, 33.3% newly diagnosed (unknown) hypertensive individuals showed microalbuminuria. Males had higher incidence of microalbuminuria as compared to female hypertensive(36.3% vs.30.5%)but it was statistically non-significant.

There was no definite trend has been observed with increasing age of unknown hypertensives. This might be due to decreased incidence of unknown hypertension with increasing age. Results are accorded with previous studies^{87,88,89}.

In present study, it was observed that hypertensive individuals with poor control of blood pressure had greater risk of having microalbuminuria than hypertensive individuals, those with controlled blood pressure. In present study, 55.9% uncontrolled hypertensives (N=34) had microalbuminuria while 28.5 % of controlled hypertensive individuals (N=21) shown microalbuminuria. It was statistically significant ($p<0.05$).

Previous studies of de Alvaro F et al.⁸⁶, Post WS et al., Nanchekeeva et al.⁹⁹ found similar results.

SUMMARY & CONCLUSION

The present study was carried out at Gundoj village of Pali, a district of western Rajasthan. A total of 200 individual were selected from community on the basis of house to house survey followed by camp approach. Out of 200 individuals, 100 were hypertensives and 100 age and sex matched normotensive individuals were taken as control. The results of the present study are summarized as follows:

The mean age of hypertensive males was 52.5 ± 7.3 yrs, in females it was 52.7 ± 4.4 yrs with gross average age of 52.6 ± 5.8 yrs. In normotensives, the mean age of males was 48.9 ± 5.6 yrs, in females it was 50.7 ± 4.4 yrs with gross average age of 49.8 ± 5.0 yrs.

1. The average systolic blood pressure of normotensive subjects was 123.9 ± 8.9 mmHg (Males= 123.8 ± 9.7 mmHg, In hypertensive subjects, the average systolic blood pressure was 152.8 ± 25.5 mm Hg (Males 153.7 ± 28.4 mm Hg, Females= 152.0 ± 22.6 mmHg).

2. The average diastolic blood pressure of normotensive subjects was 77.1 ± 12.1 mmHg (Males = 76.1 ± 18.7 mmHg, Females = 78.0 ± 5.2 mmHg). In hypertensive subjects, the average diastolic blood pressure was 89.2 ± 10.9 mmHg (Males = 90.5 ± 11.6 mmHg, females 89.2 ± 6.2 mmHg)

3. In this study, 55% of hypertensives were known hypertensives, had previous history of hypertension. While 45% of hypertensive were unknown hypertensive, diagnosed first time during our clinical examination.

Among known hypertensives only 38% hypertensive had control over their blood pressure (average blood pressure was $123.4 \pm 12.6 / 77.1 \pm 7.6$ mmHg) while 62% diagnosed hypertensive had poor control of their blood pressure (Average blood pressure was 150 ± 10.2 mmHg).

Two main patterns of hypertension are seen in this study. Isolated systolic hypertension was common in elderly subjects whereas combined systolic and diastolic hypertension was common pattern in younger and middle aged hypertensive.

The average duration of hypertension in males was 10.2 ± 5 yrs and in females it was 9.3 ± 6.5 yrs. Females had higher duration of hypertension than males. The 55% of hypertensives had high pulse pressure as compared with 8.80 % of normotensive.

The higher BMI > 25 kg/m² was observed in hypertensive subjects (35%) as compared to normotensive subjects (20%) [$p < 0.05$]

S. creatinine is a readily available and sensitive marker of renal function. Hypertensive individuals had higher mean S. creatinine 1.24 ± 0.23 mg/dl as compared to 1.02 ± 0.18 mg/dl in normotensives ($p < 0.05$).

Majority of hypertensives (56%) had S. creatinine level 21.3mg/dl while only 18% of normotensives had similar value ($p < 0.05$).

1. Creatinine clearance is a surrogate marker for GFR and a reliable & sensitive indicator of renal function. Average Creatinine clearance of normotensive group was 80.8 ± 16.01 ml/min as compared to 59.6 ± 12.5 ml/min in hypertensives. It was statistically highly significant ($p < 0.01$).

2. Among hypertensive subjects, microalbuminuria was present in 41% subjects as compared to 11% in normotensives. It was statistically significant ($p < 0.05$).

Microalbuminuria found to be associated with duration of hypertension. Least prevalence (5.6%) was found with duration of < 4 yrs while highest prevalence (76.2%) with duration of > 10 yrs.

A considerable higher prevalence (33.3%) of microalbuminuria found in newly diagnosed hypertensives.

Microalbuminuria found to be associated with level of blood pressure. Hypertensive individuals, those with higher blood pressure or poorly controlled blood pressure had higher prevalence (55.9%) of microalbuminuria than hypertensives with controlled blood pressure (28.5%). It was statistically significant ($p < 0.05$).

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