A STUDY ON "RED CELL DISTRIBUTION WIDTH IN PATIENTS ON DIFFERENT STAGES OF HYPERTENSION"

A Dissertation Submitted to

THE TAMILNADU DR. M.G.R MEDICAL UNIVERSITY CHENNAI

In Partial Fulfilment of the Regulations
For the Award of the Degree of

M.D. (GENERAL MEDICINE)

BRANCH – I

GOVERNMENT KILPAUK MEDICAL COLLEGE CHENNAI

APRIL – 2015

BONAFIDE CERTIFICATE

This is to certify that **"A STUDY ON "RED CELL DISTRIBUTION WIDTH IN PATIENTS ON DIFFERENT STAGES OF HYPERTENSION"** is a bonafide work performed by**Dr.H.VASANTHAKUMAR** , post graduate student, Department of Internal Medicine, Kilpauk Medical College, Chennai-10, under my guidance and supervision in fulfilment of regulations of the Tamil Nadu Dr. M.G.R Medical university for the award of M.D. Degree Branch I (General Medicine) during the academic period from May 2012 to April 2015.

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DECLARATION

I solemnly declare that this dissertation **"A STUDY ON "REDCELL DISTRIBUTION WIDTH IN PATIENTS ON DIFFERENT STAGES OF HYPERTENSION"**was prepared by me at Government Kilpauk Medical College and Hospital, Chennai, under the guidance and supervision of Prof.Dr.R. SABARATNAVEL MD., Professor and Head of the Department of Internal Medicine, Government Kilpauk Medical College and Hospital, Chennai.

This dissertation is submitted to **The Tamil Nadu Dr. M.G.R. Medical University, Chennai** in partial fulfilment of the University regulations for the award of the degree of **M.D. Branch I (General Medicine)**.

Place: Chennai

Date: (Dr. H.VASANTHAKUMAR)

ACKNOWLEDGEMENT

At the outset, I would like to thank my beloved Dean, Kilpauk Medical College **Prof. Dr.N.GUNASEKARAN, M.D.,DTCD** for his kind permission to conduct the study in Kilpauk Medical College.

I would like to express my thanks to medical superintendent **Prof.Dr.S.MAYILVAHANAN, M.D.** for permitting to conduct this study in Kilpauk Medical College Hospital.

I would like to thank wholeheartedly, **Prof.Dr.R.SABARATNAVEL MD.,** my unit chief and Professor of Medicine for his encouragement and guidance during the study.

I wish to express my grateful thanks to my previous chief **Prof.Dr.K.T.JAYAKUMAR MD.,** Department of General Medicine**,** for his masterly directions and his inspirational personality and helping me in choosing this topic and suggestions during every phase of this study.

I am profoundly grateful to my Assistant professor **Prof Dr. SHAIK SULAIMAN MEERAN MD.,** Govt. Kilpauk Hospital, Chennai for his constant encouragement, and unstinted co-operation which helped me at every stage of this dissertation, and valuable guidance in preparation and completion of this study.

I also extend my sincere thanks to my Assistant Professors **Dr.K.MANICKAM M.D,** and **Dr.SWARNALATHA M.D**, and **Dr.ABIRAMI M.D,** for their support.

My heartfelt thanks to **Prof.Dr.VASANTHAM.D.,** Professor and HOD, Department of Pathology for her guidance, encouragement and support.

I thank my colleagues **Dr.S.V.SANGEETHA** and **Dr.D.RAMESH** and my seniors and juniors for their timely help, cooperation and support.

I would like to thank the **institutional ethical committee**, Kilpauk Medical College for approving my study. Iextremely thankful to, Statistician **Mr.Ravanan**, for his excellent work.

I pray Almighty God to give me strength to achieve in all my endeavours.

Finally, I wholeheartedly thank all my patients for their active co-operation in this study, without which this would not have become a reality.

CONTENTS

AIM OF THE STUDY:

To detect the presence of microalbuminuria and red cell distribution width in patients with hypertension and to study, of hypertension the correlation of microalbuminuria and red cell distribution width in patients on different stages

Methods and Materials:

Patients with hypertension of varying durations coming to Royapettah Government Hospital were chosen as subjects For this study, during the period of April 2014 to September 2014.

Inclusion criteria:

Patients with essential hypertension coming to Government Royapettah Hospital

Table 2. Joint National Committee On Prevention, Detection, Evaluation, And Treatment Of High Blood Pressure (JNC 7).

Normal	< 120/80
Prehypertension	120-139/80-89
Hypertension	≥ 140/90
Stage 1	140-159/90-99
Stage 2	≥ 160/100

Exclusion criteria:

- Patients with severe anemia
- Patient with acute blood loss

A total of 50 patients were studied. All subjects were investigated in detailincluding history of symptoms and signs suggestive of target organ damage, duration of hypertension, drug history, previous blood pressure recordings, complete urine analysis, complete blood count with Red Cell Distribution width, biochemistry (urea, creatinine, FBS), ECG, 24 hours urine for microalbuminuria estimation was done by Immune Turbidmetric assay. Red cell distribution width was measured using Auto Hematology Analyser

Study design: cross sectional study design

Place of study: Government Royapettah Hospital,

Department of Medicine.

Collabrating Department: Department of hypertension, Government Royapettah Hospital,Chennai-14

Period of study: april 2014 to Sep 2014

Sample size: 50

Study population (subjects): hypertensive patients coming to Royapettah Government Hospital, Department of Intionernal Medicine and Department of Hypertens

Inclusion criteria;

Patients with essential hypertension coming to Government Royapettah Hospital

Exclusion criteria; Exclusion criteria:

- Patients with severe anemia
- Patient with acute blood loss
- **OUTCOMES:** To study the correlation brtween microalbuminuria and red cell distribution width in patients on different stages of hypertension

Sponsorship : Nil

Conflict of interest : Nil

Financial data : Nil

Consent: Informed consent from all patients

Ethical clearance : APPROVED

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KEY WORDS; Hypertesnsion stages- Red cell distribution width – correlation with -Microalbuminuria

INTRODUCTION

Even as our understanding of the underling pathophysiology of elevated arterial pressure has advanced, in 90-95% of cases the etiology (and thus potentially the preventive cure) is still largely unknown. As a consequence, in most cases hypertension has to be treated non-specifically leading to a large number of minor side effects and high non-compliance rate.[1]

If not properly treated hypertension increases the incidence of early demise ,stroke, heart failure, renal injury .

Hypertension has been ranked among the largest mortality risk factor in the world accounting for 5% of all deaths. Mild elevation in hypertension accounts for larger proportion of cardiovascular deaths due to its high prevalence.

The prevalence of hypertension in India is 59.9 & 69.9 per 1000 in males and females respectively in urban population and 35.5 & 35.9 per 1000 in males and females respectively in the rural population. [2]

Microalbuminuria has recently emerged as a marker of wide spread vascular damage in hypertension.[3] Hypertensives with microalbuminuria were found to have significantly higher prevalence of coronary artery disease, hypertensive retinopathy and cerebrovascular

disease when compared to patients without it.

Microalbuminuria is an early marker of target organ damage in hypertension.[4]

Various studies have shown a prevalence rate of microalbuminuria ranging between 4.7% to 46% in essential hypertension.

Hemodynamic load is the major determinant of albumin excretion in persons with mild hypertension and no cardiovascular complications , whereas in subjects with more severe hypertension and associated target organ damage, augmented urinary loss is probably the consequence of glomerular damage.[5]

It has been proved that microalbuminuria is a risk factor for the development of clinical proteinuria, renal failure and increased cardiovascular mortalityin insulin dependent diabetes mellitus. The studies shows that the microalbuminuria also predicts development of proteinuria and decline in renal function in hypertension.[6]

Effective diagnosis and management of hypertension is a crucial component of such efforts. High blood pressure causes of kidney injury and in advanced stages, renal failure.

Renal hypertension puts stress and increased pressure on the

kidney, and a major cause of end-stage renal disease.

Hypertensive nephropathy refers to renal injury due to chronic elevated blood pressure.

Additional complications often associated with hypertensive nephropathy nclude glomerular injury resulting in proteinuria and haematuria[i]

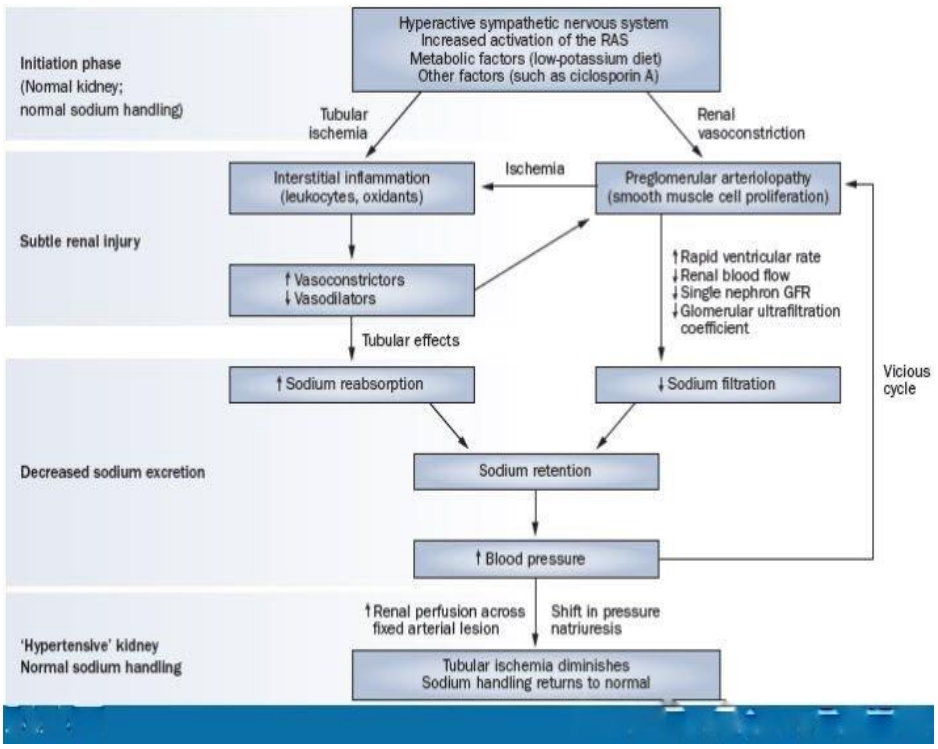


Figure showing pathophysiology of hypertensive renal disease.

People may have CKD but are not aware of it because they and diabetes, need to be assessed regularly and managed in line with established guidelines[ii].

The appropriate evaluation and treatment of hypertension is crucial in caring for patients with CKD, as blood pressure not controlled can lead to decline in kidney function and faster development of cardiovascular disease, considered the foremost cause of death in CKD patients.

As the prevalence of these risk factors associated to CKD is growing in exponential rate, a country cannot leave the burden of CKD unattended; therefore prevention, early detection, and treatment are the cost-effective strategy.

Prevention of end stage renal disease (ESRD) by early detection and treatment is an critical point in reducing the need for renal transplant.

Evaluation of hypertensive patients for the presence of CKD is critical as part of preventive care and treatment strategies. Measuring of the urinary albumin excretion have been used as a screening test for CKD in hypertensive patients.

The normal rate of urinary albumin excretion is less than 20 mg/day. Persistent of albumin excretion between 30 and 300 mg/day is termed microalbuminuria, while ,albumin excretion above 300 mg/day is considered macroalbuminuria.

It has been shown that microalbuminuria represents the

renal involvement of generalized vascular endothelial damage[iii], which is frequently seen in patients with established essential hypertension, and is a predictor for cardiovascular and probably renal injury.

Microalbuminuria is not only a simple but also an accurate method to detect a hypertensive patient at a high risk for cardiovascular and probably renal damage.

National Kidney Foundation recommend combined screening for microalbuminuria and estimated GFR for all adult patients with CVD as well as those with risk factors for CKD, such as diabetes, hypertension, and high body mass index.

Clustering microalbuminuria with other markers of endothelial function such as red cell distribution width (RDW) may contributes to the prediction of renal involvement in hypertension. The RDW is a measure of the variation of red blood cell width.

AIMS AND OBJECTIVES

1. To detect the presence of microalbuminuria and red cell distribution width in patients with hypertension.

2. To study, the correlation of microalbuminuria and red cell distribution width in patients on different stages of hypertension

REVIEW OF LITERATURE

Historical review

Though the disease has existed since antiquity, it became possible to recognize it only after the discovery of a devise to measure it.

It was William Harvey and Lennaec who discovered circulation of blood in early 1600 and Stethoscope in 1819 respectively. Vierordt a German scientist was the first person to invent an instrument that measures blood pressure on early1850s.

Though blood pressure measurement using this instrument was time consuming, he is considered the pioneer in formulating the principle behind the estimation of blood pressure, that is, by obliterating the pulse which is followed even today.

It was Rivarocci who devised auscultatory method of finding blood pressure .

Ever since the discovery of the instrument, many studies have been done throughout the world and high-lightened the necessary for addressing the disease.

Definition

The definition of hypertension is usually taken as that level of pressure associated with a doubling of long terms risk. Perhaps the bestoperational definition is "the level which the benefits (minus the risks and costs) of actionexceeds the risks and costs (minus the benefits) of inaction [iv]

As per the of JNC VII report on prevention, detection, evaluation and treatment of high B.P. [v]

Table 2

Blood Pressure Classification in Adults (JNC 7)

BP Classification	SBP (mm Hg)	DBP (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

These definitions apply to adults who are not on anti hypertensive agents and who are not acutely ill. When systolic and diastolic blood pressure fall into different categories, the higher category should be selected to classify the individual's blood pressure status.

Optimal BP with respect to cardiovascular risk is < 120 mm Hg systolic and < 80 mm Hg diastolic, based on the average of two or more readings taken at each of two or more visits after an initial screening.

Guidelines for measurement of BP [vi]

"Patient conditions

***Posture*:**

For patients older than 65 years, diabetic or is receiving antihypertensive therapy, check for postural changes by taking readings after 5 min of supine, then immediately 2 min after standing.

For routine follow up, a patient should sit quietly for 5 min with arm bared and rested at the level of the heart and the patient comfortably resting in a chair.

Circumstances:

Patient should have no coffee and should not have smoked with in 30minutes preceding the readings.

Patient should have ingested no exogenous adrenergic stimulants(e.g.phenylephrine in nasal decongestants). Readings should be obtained in a quite, warm setting."

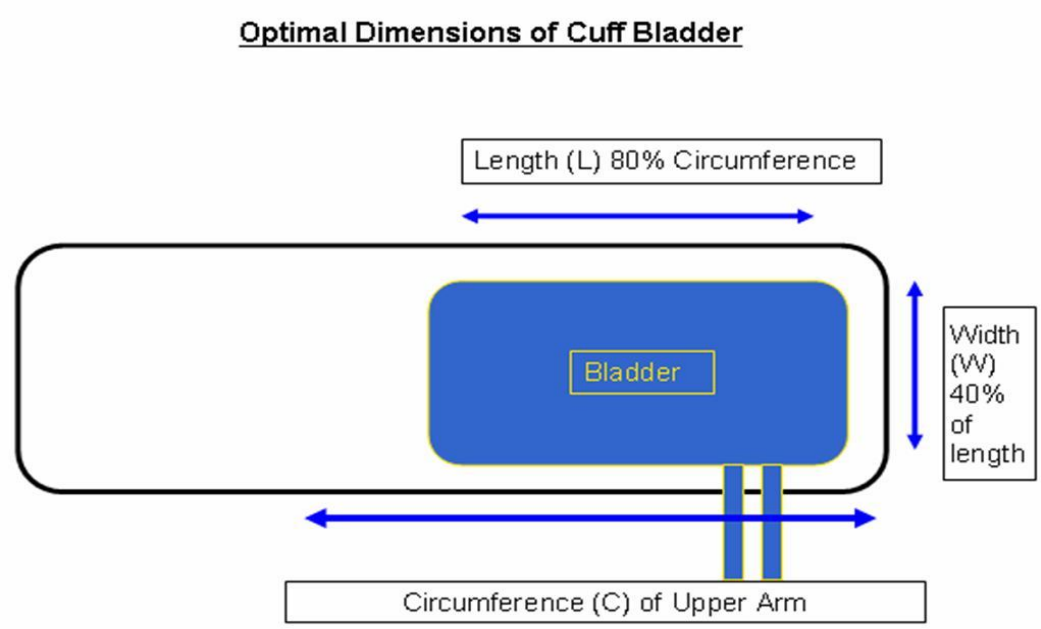
“Equipment

Cuff size:

The bladder should encircle at least 80% of the circumference and cover 2/3rd of the length of the arm; if it does not, place the bladder over brachial artery. A too small bladder may cause falsely high readings.

Monometer: Use a mercury, recently calibrated aneroid, or validated electronic device.

Stethoscope: To avoid interference the bell of the stethoscope should be used and the cuff has be placed with the tubing at the top.



Technique

Number of readings

On each occasion, take at least 2 readings, separated by as much time as is practical; if readings vary by > 5 mm of Hg, take additional readings until two readings are close."

Performance

Position the bell of the stethoscope over the brachial artery (confirm the bell setting by lightly tapping it) and rapidly inflate the cuff to 20-30 mm Hg above the systolic blood pressure determined by palpatory method [to detect an auscultatory gap].

Deflate the cuff at a rate of 2 mm Hg / second, listening for phase 1 and phase V phase IV for children] Korotkoff sound. Phase 1 is the first appearance of any sound and phaseV at the disappearance of the sound which is the DBP in adults.

Listen for 10-20 mm ofHg below phase V for any further sound, then deflate the cuff rapidly and completely and allow the subject to rest for at least 30 seconds.

If Korotkoff sounds are weak, then ask the patient to raise the arm and open & close the hand for 5-10 times, then inflate the bladder quickly.

Recordings

Note the pressure, patient positions, the arm, cuff size [e.g. 140/90 mm Hg, seated, right arm, large adult cuff]"

MECHANISMS OF CONTROL OF ARTERIAL PRESSURE

Knowledge of mechanisms depends mainly on laboratory data, which rely more on measurements of mean arterial pressure than on systolic or diastolic pressure.

Mean arterial pressure is not the midpoint between systolic and diastolic pressure but it is approximated by adding $1/3^{rd}$ of the pulse pressure to the diastolic pressure.

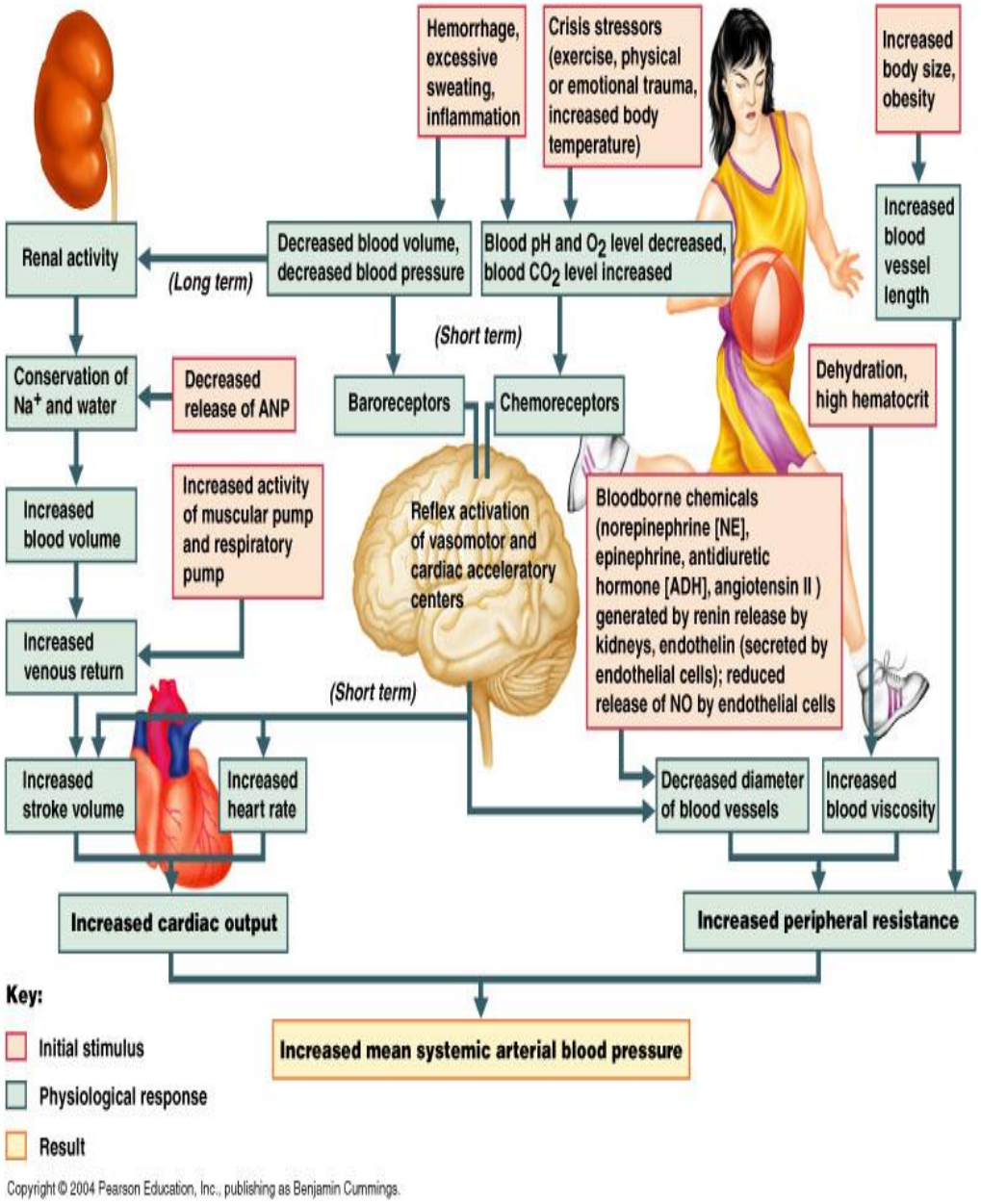
It is the result of variable interactions between the ejection blood flow from the left ventricle, the arterial blood volume and the capacitance, diameter and physical properties of the entire arterial tree, from aorta to terminal arterioles, collectively known as arterial resistance.

In general terms, biological control systems tend to operate at 3 levels.

- By rapid response through nervous system
- By delayed response operating humorally
- By long-term adaptive response which may involve

modification of the composition and behavior of any or the all body systems.

Each of these 3 involves a sequence of control systems, so that when one fails a backup system comes into operation at a cruder level.



Cardiac output and peripheral resistance

Variations in arterial pressure therefore represent variations in the product of cardiac output and peripheral resistance. In practice peripheral resistance is never directly measured, it is measured from the observed quantities, cardiac output and mean arterial pressure as given by Frank's formula.

Resistance = mean pressure (mm hg) x 1330 / Cardiac output (ml per secs).

Regulation of cardiac out put

Altering responses from the cerebral cortex and feed back responses in the brain stem mainly regulate cardiac output in man. These operate on heart rate, accelerating it through the sympathetic nerve and decreasing it through the vagus nerve.

Starlings Law of heart

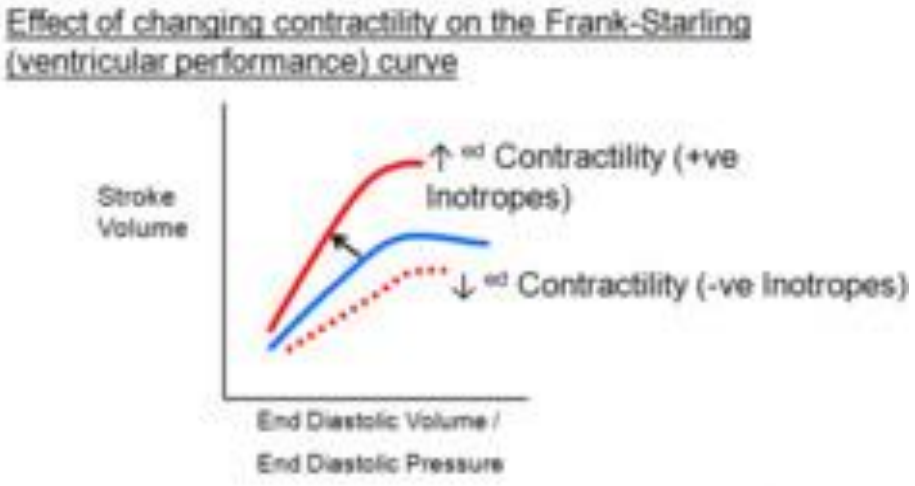
Increased diastolic filling lengthens heart muscle fibers and thus increases stroke output. Increased venous return is a main determinant of cardiac output, but operates for short of the break down point of raised diastolic filling. Output rises in anticipation of exercises through CNS pathways originating in the cortex, and during exertion through accelerated venous return, caused by the pumping action of

muscles. Peripheral resistance is reduced by dilatation of the smaller arteries and arterioles.

All these mechanisms operate synchronously to produce a strictly linear relation between rising cardiac outputs and rising oxygen uptake during exercise, though arterial pressure rises in anticipation of exercises, the rise is much smaller than the rise in heart rate.

Cardiac output is probably normal in early and middle stage hypertension and is maintained up to end stage hypertension, when it falls.

FRANK STARLING LAW



+ve Inotropes shift the Frank-Starling curve upwards and to the left such that SV is increased at a particular level of EDV.
-ve Inotropes shift curve down and to the right

Autonomic control of arterial pressure

Peripheral resistance and cardiac output both are mainly dependent on autonomic nervous system control.

All autonomic reflex pathways involve the CNS at least at spinal levels and these cannot be isolated from their higher nervous connections in life.

Sympathetic adrenal system

From the functional point of view, the motor or cells of the sympathetic system are situated in the paravertebral cervical and preaortic abdominal ganglia. The cell of the lateral horn is the connector cell. The afferents for sympathetic reflexes come from all parts of the body. Many of the reflexes pass through the vasomotor center of the medulla, but in some it is through spinal, notably those excited by a deep breathe and those from full bladder. This is equally true with the adrenal medulla, which releases its effector hormones in the same way as the ganglion cells and the post ganglion axons of the sympathetic nerves. The effects of stimulating sympathetic adrenal system are broadly to reduce blood flow through the skin, gut, and to a smaller extent to the kidneys and to increase flow through the voluntary muscles and heart muscle. Blood flow to brain remains more or less constant.

The cerebral arteries are poorly innervated and are poorly responsive to adrenaline .

Total blood flow at rest is 5.8 lts/ min of which 750 ml (13%) goes to the brain, 1400 ml (24%) to the gut, 1100 ml (19%) to kidneys, 250 ml (4%) to the heart and 1200 ml (21%) to the voluntary muscles. Blood flow during exercise increases by 4 fold to 25 lts / min and brain flow remains the same. Gut flow falls nearly by 5 fold, kidney flow falls four by folds and voluntary muscle flow increases by 18 times.

Baroreceptor reflexes

The sympathetic adrenal system is a final common pathway both for changes initiated consciously at cortical level (fear, anger and planned adventure) and for vascular reflexes that remain intact in the spinal animal. The most important vascular reflexes are those of baroreceptors.

At the origin of internal carotid arteries and scattered within the aortic arch, there are specialized stretch receptors arranged in layer between the outer coats of these vessels. Stimulation of these receptors either by stretching or by direct electrical stimulation, results in a fall in arterial pressure through reflex slowing of heart and vasodilatation of skin, voluntary muscles, gut and kidneys. This

reflex arc passes from the baroreceptor by afferent nerves to the brainstem and hence through the vagus to the heart. The reverse response, raises pressure by sympathetic arteriolar constriction and adrenaline release.

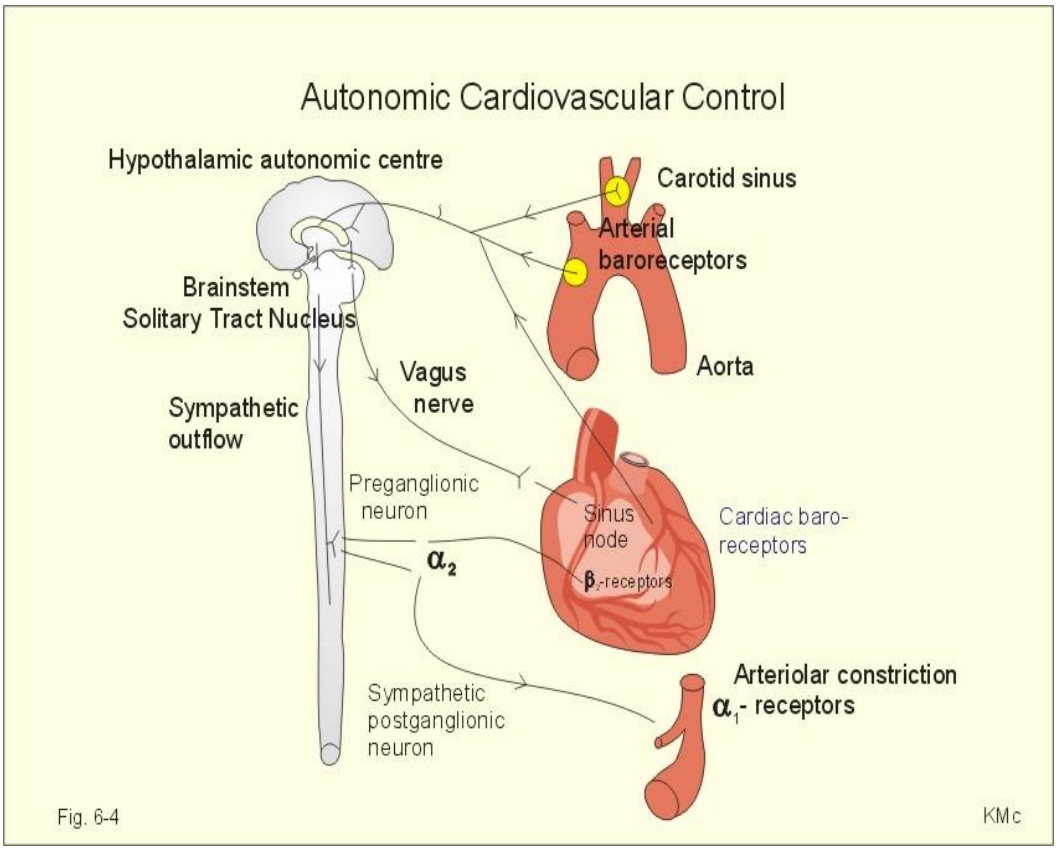
The renin angiotensin system

Renin is an enzyme produced from cells surrounding the afferent arterioles of the renal glomeruli [the juxta glomerular apparatus]. It acts on a plasma substrate produced in the liver, to yield angiotensin, the most potent vasoconstrictor.

The main stimulus for renin release from Juxtaglomerular apparatus is low sodium intake [10 m mol / day] or increased sodium output as in use of diuretics.

Renin release is depressed by high sodium intake. As well as its peripheral role in arteriolar constriction, angiotensin acts centrally on brain stem, causing increased sympathetic discharge The renin angiotensin system also controls the release of aldosterone which in turn controls sodium output from the renal tubules and hence blood volume.

Aldosterone secreting tumors of adrenal gland are rare cause of hypertension.



Integration of pressure control in CNS

In man, none of the mechanisms described can operate independently of central control in the integrative centers of brain stem, which include a pathway from the vasomotor center, down the spinal cord to the sympathetic preganglionic nerves in the lateral horn of the gray matter. It is an adrenergic system, which operates to raise pressure.

There is probably also a brain stem inhibitory system, also adrenergic, with an uncrossed pathway from the brain stem to the vagus. These brainstem centers receive feedback information from the

viscera, and respond within wide limits to information from the cortex.

The effects of actual or anticipated maximal exertion on arterial pressure are striking. Mental excitement is probably a commoner cause of sympathetic activation,tachycardia, and raised arterial pressure. Stress in the form of mental exertion such as mental arithmetic increases heart rate by 30% and arterial pressure by 10%. Evidence of the normally predominant control of pressure by the brain is the fall in pressure during sleep. This accounts to about 20% in both systolic and diastolic pressure, compared with mean waking pressure.

Fully automotive portable recorders attached to intra-arterial catheters made all these measurement on which this estimate is based.

Association of hypertension with other conditions

Obesity

Hypertension is more common among obese individuals and probably adds to their increased risk of developing IHD. In the Framingham study adiposity as measured by subscapular skin fold thickness was the major controllable contribution to hypertension. Even small amounts of weight gain are associated with a marked increase in incidence of hypertensive and coronary mortality.

Children seem particularly vulnerable to the hypertensive effects

of weight gain.

Therefore avoidance of childhood obesity with the hope of avoiding subsequent hypertension seems to be important.

Sleep apnea: one of the contributors to the hypertension in obese people is sleep apnea.

Snoring and sleep apnea are associated with hypertension, and this in turn may be induced by increased sympathetic activity and endothelin release in response to hypoxemia during apnea.

Physical inactivity

Physical fitness may help to prevent hypertension and persons who are already hypertensive may lower their blood pressure by regular isotonic exercise

Alcohol intake

Even in small quantities, alcohol may raise blood pressure. In large quantities alcohol may be responsible for a significant number of cases of hypertension.

In all studies of this problem, some have found a linear, progressively increasing level of BP with increasing consumption of alcohol, most report a threshold effect, where as some find lower levels

of blood pressure among those who drinks 1-2 ounces a day than among those who do not drink at all.

The reduction in coronary disease in persons who ingest small quantities of alcohol beyond any effect on blood pressure, may reflect a greater mobilization of tissue free cholesterol for hepatic removal and excretion. The pressure effect of alcohol primarily reflects on increase in cardiac output and heart rate possibly as a consequence of increased sympathetic activity.

Smoking

Cigarette smoking raises blood pressure, probably through the nicotine induced release of nor epinephrine from adrenergic nerve endings. The increased risk of stroke among cigarette smokers probably involves an acute fall in cerebral blood flow. When smokers quit smoking, a trivial rise in blood pressure may occur, probably reflecting a gain in weight.

Diabetes mellitus

Hypertension is present in about 2/3rd of patients with diabetes who have the associated intracapillary glomerulosclerosis described by KIMMERSTEK and WILSON and prevalence of hypertension in the overall population of diabetes has increased. The co-existence of diabetes and hypertension almost redoubles the already high rate of

cardiovascular mortality seen in non-diabetic hypertensives.

Diabetics are also susceptible to special problems associated with antihypertensive therapy. Diuretics may exacerbate the carbohydrate intolerance probably by inducing potassium deficiency. Those in whom the condition is brittle and who are prone to hypoglycemia may have difficulties with beta-blockers, ACE inhibitors are effective in reducing high intraglomerular pressure.

Polycythemia

Polycythemia Vera is frequently associated with hypertension. More common is a pseudo or stress Polycythemia with a high haematocrit and increased blood viscosity but contracted plasma volume as well as normal red cell mass and serum erythropoietin levels.

Gout

Hyperuricaemia is present in 25-50% of individuals with untreated primary hypertension, about 5 times the frequency found in normotensive individual.

Hyperuricaemia likely reflects decreased renal blood flow, presumably a reflection of nephrosclerosis, when diuretics are used, uric acid level rises further.

Types and causes of hypertension [vii viii ixx]

A. Systolic and diastolic hypertension

    1. Primary, essential or idiopathic

    2. Identifiable causes [secondary hypertension]

i.Renal

    A. Renal parenchymal diseases

        a. Acute glomerulonephritis

        b. Chronic nephritis

        c. Polycystic disease

        d. Diabetic nephropathy

        e. Hydronephrosis

B. Renovascular disease

    a. Renal artery stenosis

    b. Intrarenal vasculitis

C. Renin producing tumors

D. Primary sodium retention [Liddle's Syndrome, Gordon's Syndrome]

ii. Endocrine disorders

    a. Acromegaly

    b. Hypothyroidism

    c. Hyperthyroidism

d. Hypercalcemia [hyper parathyroidism]

e. Adrenal disorders f. Extra adrenal chromaffin tumors

g. 11-® hydroxy steroid dehydrogenase deficiency or inhibition [licorice]

h. Carcinoids

i. Exogenous hormones

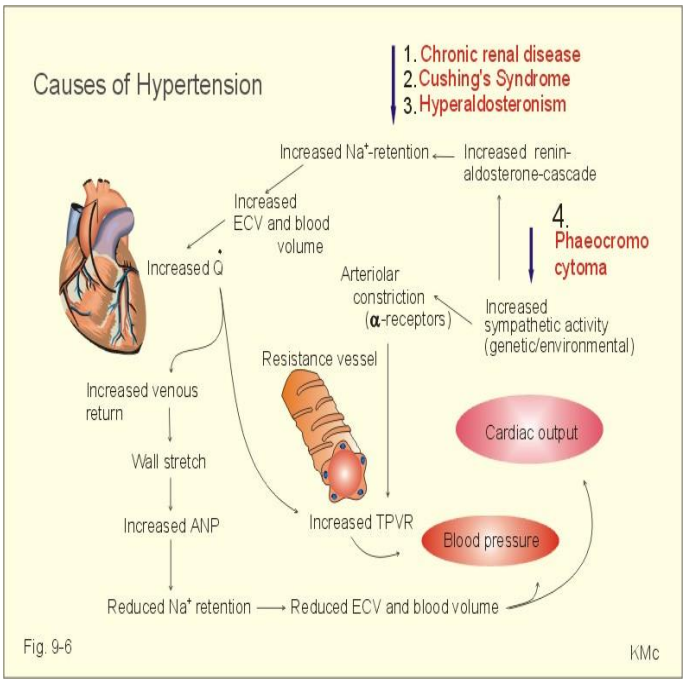
❖ Cortical disorders

❖ Cushing syndrome

❖ Primary aldosteronism

❖ Congenital adrenal hyperplasia

❖ Medullary tumors [pheochromocytoma]



- ❖ Foods containing tyramine and monoamine oxidase inhibitors.
- ❖ Coarctation of aorta and aortitis
- ❖ Pregnancy induced hypertension

Neurologic disorders

Increased intra cranial pressure

1. Brain tumor
2. Encephalitis

Sleep apnea

Quadriplegia

Acute porphyria

Familial dysautonomia

Lead poisoning

Guillian barre syndrome

B. Systolic hypertension

1. Increased cardiac output

- Aortic regurgitation
- Thyrotoxicosis
- Patient ductus arteriosis
- Arteriovenous fistula
- Hyper kinetic circulation
- Paget's disease of bone
- Beriberi

2. Decreased compliance of aorta [atherosclerosis]

Clinical features of hypertension

The majority of patients with hypertension have no specific symptoms referable to blood pressure elevation and will be identified only in the course of physical examination

***Headache*:** is characteristic only for severe hypertension which is commonly localized to occipital region. It is usually present when patient awakens in morning and subsides spontaneously after several hours.

Other possible related complaints include

- *Dizziness*

- *Palpitation*
- *Easy fatigability*
- *Impotence*

Complaints referable to vascular disease include:

- Epistaxis
- Haematuria
- Blurring of vision due to retinal changes
- Dizziness due to TIA
- Angina and dyspnoea due to cardiac failure

Clinical evaluation of essential hypertension

A strong family history of hypertension along with the intermittent finding of elevated pressure in the past favours the diagnosis of hypertension.

Elicit risk factors: Smoking, Diabetes, Renal disorders.

Asses patients' life style: Diet, physical activity, family status, and work.

Physical examination

Starts with general appearance: Round face and truncal obesity –

Cushing syndrome

If muscular development of upper extremities is out of proportion to lower limit-Coarctation of Aorta.

Compare the BP and pulse in both extremities, in supine and standing

Measure patients height and weight

Fundus examination because this provides clues to the duration and prognosis of hypertension.

Palpation and auscultation of carotid arteries for evidence of stenosis or occlusion

Examination of cardia

- For evidence of left ventricular hypertrophy and cardiac decompensation
- For left ventricular lift
- For 3^{rd} and 4^{th} heart sounds

Examination of lungs

- For pulmonary rales.
- Extra cardiac murmurs and palpable collateral vessels as seen in Coarctation of aorta.

Examination of abdomen

Auscultation for bruits originating in stenotic renal arteries, these have diastolic components, best heard just right or left of midline, above umbilicus

Palpation for aneurysms and enlarged kidneys

Examination of extremities for oedema

Search for evidence of previous Cerebro vascular disease

Laboratory investigations

- Urine for protein, sugar, and blood,
- Microscopy.
- Complete blood count with RED CELL DISTRIBUTION WIDTH
- Serum creatinine, blood urea, serum electrolytes
- Fasting blood glucose
- Total cholesterol
- ECG

Microalbuminuria as a marker for cardiovascular disease in subjects with hypertension

The main function of the Kidneys, the major excretory organ of the body. is filteration of the blood and the removal toxic molecules and products of metabolism (example; creatinine and urea) and also,if present, any extra fluid for the body to maintain appropriate blood volume .

The kidney also does reabsorbing water and necessary important molecules including electrolytes (example; sodium and potassium) and proteins.

Blood filtration occurs in the nephron, which are the functional unit of the kidney.

Normally,in each of the kidneys there are more than a million nephrons. Blood filtration occurs in the tubules and glomerulus in each nephron. Filtration membrane is present in the glomerulus which consisting of three layers:

The endothelium,

The epithelial podocyte

The basement membrane.

The glomerular filtration membrane permits certain blood substances to pass through it in order to reach the tubular system which consists of four parts:

The proximal convoluted tubule,

Loop of Henle,

Distal convoluted tubule

And collecting duct

In the renal tubular system, most of reabsorption process occurs. Glucose and plasma proteins are readily reabsorbed in the proximal tubule . In the loop of Henle, concentration of urine takes place through reabsorption of water. Sodium and potassium ions regulation takes place in distal tubules. Final reabsorption of ions takes place in the collecting duct.

The flows of blood to the kidney is through the renal artery.

The renal artery then branches into the segmental arteries which further divides to different lobular arteries . These arteries further branch into interlobular arteries that divide to form afferent and efferent arterioles The afferent arterioles are the one which is responsible for supply of blood to the glomerulus while removal of blood from of the glomerulus is through efferent arterioles.

By vasoconstriction or vasodilation both the afferent and efferent arterioles plays avital role in regulating the pressure in glomerular capillary.

Protein reabsorption

Serum proteins play major roles in the body including transporting essential molecules such as hormones, vitamins, lipids, minerals and exogenous substance such as drugs.

Proteins also maintain the oncotic pressure between the plasma and interstitial space, and are involved in the synthesis of enzymes and other substances.

Proteins in the blood can be divided into, for example, carrier proteins such as albumin, immune system proteins such as immunoglobulin and acute phase proteins such as CRP.

The most abundant serum protein is albumin, accounting for 60% of serum protein and with a concentration of 3.4 - 5.4 g/dL. Albumin is a highly soluble single polypeptide which consists of 585 amino acid sequence.

Each day, 9 - 12 g of albumin is produced by the liver. More than 70% of oncotic colloid pressure is controlled by albumin.

Levels of albumin are affected by factors including endogenous

molecules such as insulin and cortisol.

As mentioned earlier, kidney reabsorption of albumin and other proteins that pass the glomerular filtration membrane occurs in the proximal convoluted tubule. This reabsorption process is achieved by receptor-mediated endocytosis.

A receptor complex called megalin-cubilin is involved in the endocytosis process. The reabsorption process can be summarised as follow: albumin binds to the megalin-cubilin receptor complex in the apical plasma membrane.

After that, an adaptor molecule binds to the tail of the receptor complex to help the internalisation of the ligand-receptor complex (Cui et al., 1996). Once the internalization process occurs, an endocytic vesicle transports the formed complex to the endosomal compartment where the protein complex dissociates by vesicle acidification. Albumin then undergoes degradation in the lysosome to its original amino acids which return to the blood stream.

Kidney [xi]

Proteinuria and microscopic haematuria takes place as a result of lesions of glomerulus and also more or less 10% of deaths caused by hypertension are attributed to renal failure.

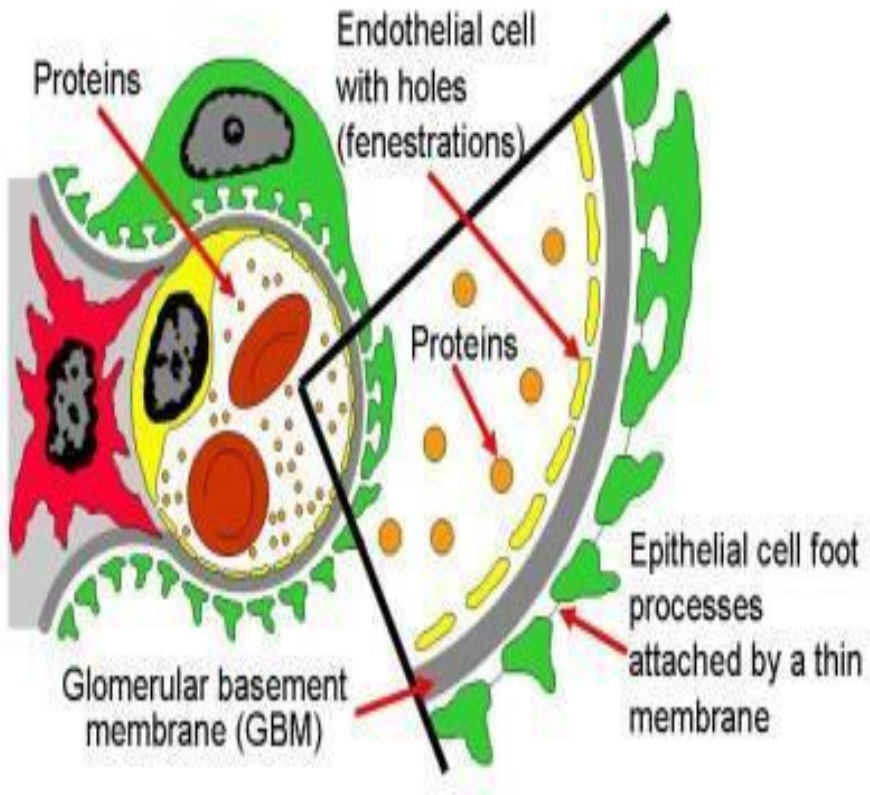
Blood loss in hypertension occurs from renal lessions.

Microalbuminuria

Microalbuminuria has recently been considered, to be an early marker of widespread vascular damage ,that is, target organ damage in essential hypertension.[xii,xiii]

Since Microalbuminuria is also associated with a constellation of metabolic and non-metabolic risk factors, it may indicate the presence of more generalized damage to microvascular structures in hypertensive patients. Hypertensives who are found to have microalbuminuria are also noted having a greater prevalence of disease of coronary artery and cerebrovascular beds when compared with their normoalbuminuric counterparts Microalbuminuria might be an early marker of renal involvement by systemic disease among which hypertension is one of the important cause.[xiv]

On examining the relation between microalbuminuria and to renal structural changes, it was noted that increase in albumin excretion was present with hypertension, or decrease in creatinine clearance, were associated with already established abnormalities involving glomerular structures.



It includes, increase in the thickness of glomemular basement membrane and mesangium enlargement This implies that microalbuminuria is not only a predictor of renal involvement in hypertension but rather considered a marker of early nephropathy.

Hypertensives having microalbuminuria manifest increase in levels of blood pressure, especially at night and higher value of serum cholesterol, TGL and uric acid than patients with normal urinary albumin excretion.[xv]

Level of high-density lipoprotein on the other hand was lower in patients with microalbuminuria than in those without it. Patients with microalbuminuria showed a greater prevalence of insulin resistance and thicker carotid arteries than patients with normal urinary albumin excretion.[xvi]

Rate of creatinine clearance in patients with microalbuminuria decreased more than that in those with normal urinary albumin excretion. In conclusion, studies suggest that hypertensive patient manifesting microalbuminuria harbor variety of biochemical and hormonal derangements with adverse impact, which result in hypertensive patients having a greater incidence of cardiovascular events and a higher fall of renal function than patients with urinary albumin excretion at normal quantity. [xvii]

In 1960's the first description of microalbuminuria was made in patients who were newly diagnosed with type 2 diabetes in the Diabetes detection study in Bedford, in United kingdom , by the use of a new more sensitive assay for urinary albumin.[xviii]

Urinary albumin excretion was found to correlate significantly with blood Pressure, more specifically the systolic blood pressure.

It lead to the observation that hypertension and hyperglycemia may both combine to increase the degree of albuminuria.

It is now widely accepted that microalbuminuria signifies a more generalized vascular problem, not restricted just to the renal microcirculation, but is itself independently associated with more extensive vascular pathology. It is observed that, microalbuminuria is present in a significant proportion of the non-diabetic population, especially in association with systemic arterial hypertension, and it appears to predict the incidence of cardiovascular disease.[xix, xx, xxi, xxii, xxiii, xxiv, xxv] Studies now shows that, the renal architecture is better preserved by antihypertensive treatment and thus function of renal sysem is better maintained on long term follow up.

There is now a consensus to treat patients with microalbuminuria with Angiotensin converting enzyme inhibitors or alternative blood pressure lowering treatment even in the presence of so-called normal blood pressure.[xxvi, 33]

Epidemiology of Microalbuminuria in Essential Hypertension

Between 2 and 10% of the adult non-diabetic population has been found showing persistent microalbuminuria, with a higher frequency in certain ethnic groups such as Afro-Caribbean's, Afro-Americans, Pacific islanders and Australian Aborigines.

Patients having essential hypertension shows a positive proteinuria in between 4 and 16% of cases, however the prevalence of microalbuminuria is reported with wider variation in the range of 5 and 37%. Microalbuminuria is found to be more common in the older population and in males.

Both microalbuminuria and overt proteinuria are noted to be associated with an Hypertrophied left ventricle, myocardial ischaemia, thickness of carotid artery and overall cardiovascular morbidity and morality. Recent studies suggest that microalbuminuria is an independent risk factor for cardio vascular injury.[xxvii xxviii]

Proteinuria even present in small quantities have found to be toxic to nephrons. In study it has been found that persons with microalbuminuria even at levels too low to detect with standard dipstick tests have an increased risk for preclinical nephropathy and also cardiovascular morbidity and mortality. [xxix]

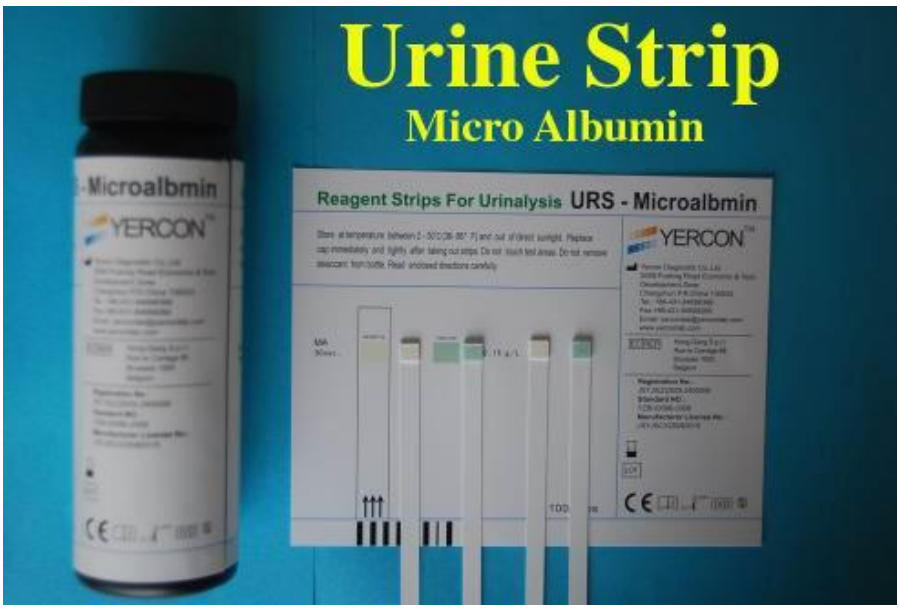
DEFINITION OF MICROALBUMINURIA

The median daytime excretion of albumin, which is the major plasma protein is 4 to 6 μg /minute in population – based studies, and the 90^{th} percentile is about 20μg/minute or 30 mg/ 24 hours.

The standard urinalysis dipstick can detect albumin only at levels greater than 30mg/ dl – 300mg/ 24hours if the output is 1L, anything above this level of excretion is called *macroalbuminuria.*

Microalbuminuria may be cited as the range in between: urinary excretion of albumin of 20 to 200 μg/minute or 30 to 300mg/ 24 hours. [xxx]

Diagnostic definition of normo-, micro-and macroalbuminuria [xxxi]			
Condition	**24-h urinary albumin**	**Over night urinary albumin**	**Albumin: creatinine ratio***
Macroalbuminuria (Overt nephropathy)	> 300 mg/day	> 200∝g/min	> 25mg/mmol
Microalbuminuria	30-300mg/day	20-200∝g/min	2.5 –25mg/mmol (for men)
Normoalbuminuria	< 30mg/day	< 20∝g/min	< 2.5 mg/mmol (for men) < 3.5mg/mmol (for



The concentrations of albumin and creatinine in the first urine sample in the morning correlate very well with those in 24 hours sample, and an overnight albumin-to creatinine ratio greater than 2mg/ mmol predicts urinary albumin excretion in the range of microalbuminuria with high sensitivity and specificity.

Thus, it is not always necessary to obtain a 24-hours urine sample to have a reliable evaluation.

Furthermore, the concentration of albumin in these early urine samples is highly predictive of morbidity and mortality in high-risk population.

Mechanism of association between microalbuminuria and hypertension[xxxii]

There are at least three ways by which increased urinary albumin excretion rates Can occur:

- Increased intraglomerular pressure;
- Glomerular injury causing disruption of the glomerular filtration barrier;
- Tubular damage cumulating in loss of normal reabsorption of filtered albumin .

Increased intraglomerular pressure

Pressure within the glomerulus is determined by the balance between the Equilibrium between constriction and dilatation of the afferent and efferent arterioles of the glomerulus. Arteriolar tone is regulated by a range of mechanisms and pressor/ depressor substances. If auto regulatory function of these arterioles is defective, it results in raised intraglomerular pressure.

For example, the afferent arteriole normally protects the glomerulus against raised systemic blood pressure by vasoconstriction. Conversely, vasoconstriction of the efferent arterioles will tend to increase intraglomerular pressure.

Many studies, both in humans and animals, suggest that loss of normal auto regulatory function is likely to be involved in development of raised intraglomerular pressure leading to protein leakage and renal injury. The mechanisms include increased sympathetic nervous system activation, hyperinsulinemia, decreased production of vasodilator hormones and activation of the rennin-angiotensin system.

Interestingly, ACE inhibitor drugs which are thought to act in part by causing relaxation of the efferent arteriole have, been associated with reduction in protein leakage and renal protection in both patients with and without diabetes.

It is also possible that systemic hypertension is directly responsible for the renal haemodynamic changes facilitating protein leakage. Systolic blood pressure has been particularly strongly correlated with development of microalbuminuria.

Changes in glomerular barrier filtration

Selectivity of the basement membrane of glomerulus is important to normal glomerular function and may be deranged in association with microalbuminuria. In patients with diabetes, glycation of long- lived tissue proteins may cause loss of Polarity causing albumin loss. This association between microalbuminuria and impairment of charge selectivity has recently been shown in individuals with no diabetes.

These abnormalities have been associated with vascular endothelial and vascular permeability factors.

One hypothesis is that microalbuminuria is the renal manifestation of generalized vascular endothelial dysfunction, which could explain the strong link cardiovascular disease and may have a genetic basis. In support of this, it has been reported that, the microalbuminuria:

- Is associated with reduced size and charge selectivity of the glomerular vessel wall in healthy people

- Is an independent markers of systemic vascular albumin leakage
- Correlates with von willebrand's factor antigen, factor VIII hyperactivity, endothelial cell damage.
- Atherosclerosis *per se* is also associated with renal and systemic vascular leakage.

The Orion diagnostic urinary albumin assay is an immunoturbidimetric, diagnostic assay for quantification of albumin in human urine by means of clinical chemistry analyzer. The original diagnostic microalbuminuria assay is based on the measurement of immunoprecipitation in liquid phase. Antibodies against human albumin are added to an aliquot of patient urine and Reaction buffer. The antibodies undergo an agglutination reaction with albumin in the urine resulting in an increase in the turbidity of the mixture.

Turbidity is measured by using a clinical chemistry analyzer at a wavelength of ca.405nm. Microalbuminuria, cat. No. 67352content. The reagents contains sodium azide as preservetive, Store at 2…8°c. The calibrators have been standardized using the IFFC preparation CRM 470.as primary reference material.

Additional Reagents

- 0.9%Nacl solution or 0.01mPBS (PH 7.2) in case the application needs a zero calibrator.
- 0.9%Nacl solution for sample dilution, in case the concentration obtained exceeds the measurement range.

Assay procedure

Sample preparation:

Microalbuminuria assay is performed in urine. Adding preservatives is not recommended. If the test cannot be performed immediately, the urine may be stored at 2…8°c for 14 days. Urine samples should not be frozen. Turbid samples can be centrifuged before assaying (e.g. 2000 · g for 15 min).

A 24 - hour urine sample is needed On day 1,urinate into the toilet upon arising in the morning Collected all subsequent urine (in a special container) for the next 24hours.

On day 2, urinate into the container in the morning upon arising Cap the container, label the container with patient name, the date, the time of completion, and return it as instructed Deliver it to the laboratory or your health care provider as soon as possible upon completion.

Use 12-hour night collection or 24 hours collection. Centrifuge urine samples. Screen these samples using an albumin test strip. If the result is negative (approx, below 300mg/1) analyse the samples undiluted. If the result is positive, dilute the sample e.g.,1:5 (1+4) with 0.9% NaCI solution to obtain a concentration within measuring range. Multiply the results obtained by 5.

Antiserum reagent dilution

Dilute albumin antiserum with reaction buffer according to the instructions for instrument.

Calibration curve: The references are ready-to-use The concentrations of references and control are marked on the bottle. Measurement range; Ca .8-160mg/1 Use urine Albumin control (cat. No.67352) for checking the level.

The clinical chemistry analyser displays albumin concentration as mg/l (=∝g/ml).

The **albumin excretion rate** for a timed urine sample (∝g/min) can be calculated using the following formula:

(Total urine volume (ml) / Collection period (min)).

Urine albumin value (mg/') = albumin excretion rate (∝g/min) ***]***

Normally less than 150mg of protein per day (or 10mg per deciliter) are excreted in the urine. The proteins are derived from plasma and the urinary tract. About one –third of the protein is comprised of urine albumin, about one- third small globulins, and about one- third is Tamm-Horsfall protein (a glycoprotein that is secreted by distal tubular cells).

Most of the filtered proteins are normally reabsorbed by the proximal tubular cells; so little or no protein normally appears in the urine

Concomitant factors of microalbuminuria

Microalbuminuria and serum lipids:[xxxiii]

In patients with essential hypertension, the combined presence of microalbuminuria and hyperlipidemia is frequent, and greater levels of urinary albumin excretion correlate significantly with higher serum levels of TGL and apolipoprotein B and lower serum levels of high- density lipoprotein (HDL) cholesterol. Using multiple regression analysis, it is observed that lipoprotein (a) was among several variable that correlate better with microalbuminuria Also the urinary loss of protein may cause increase in serum lipoprotein levels. More over, some studies have indicated that even loses of small amounts of albumin in the urine may be associated with substantial alterations in serum lipoprotein levels in patients with diabetes.

An alternative explanation for the association between microalbuminuria and hyperlipidemia is that the hyperlipidemia causes renal damage and the increase in urinary albumin excretion. [xxxiv]

Microalbuminuria, Insulin resistance and Hyperinsulinemia in Hypertension:

Several investigators have described the presence of insulin resistance and hyperinsulinemia in a substantial number of patients with essential hypertension. Several lines of evidence also suggest that, hypertensives patients with hyperinsulinemia excrete greater amount of urinary albumin, as the presence of increased urinary albumin excretion in subject without diabetes predicts the future development of NIDDM.

Thus, microalbuminuria can be considered a manifestation of the metabolic derangements that predispose to NIDDM

Microalbuminuria and cardiovascular disease:

Also increase in urinary albumin excretion is associated with an increased incidence of cardiovascular complications and the morbid events such as left ventricular hypertrophy, myocardial ischaemia and hypertensives retinopathy.

The predictive value of microalbuminuria persists even when the data are corrected for age, sex, and obesity and levels of blood pressure. Some studies have showed that an increase in urinary albumin excretion also manifested an increased thickness of the coronary artery, a recognized marker of urinary albumin excretion atheroslcersis. [xxxv]

Microalbuminuria and endothelial dysfunction co-exist in patients with essential hypertension. In many studies it was found that Von-willebrand's Factor (VWF)concentrations are higher in hypertensives patients with microalbuminuria than in patients without microalbuminuria.

Albuminuria in essential hypertension may reflect systemic dysfunction of vascular endothelium, a structure intimately involved in permeability, hemostasis, fibrinolysis and blood pressure control. This stepwise logistic regression analysis showed that urinary albumin excretion was the most important independent predictor for cardiovascular complication, followed by diastolic blood pressure and serum cholesterol.

STUDIES SHOWING RELATIONSHIP BETWEEN MICROALBUMINURIA AND HYPERTENSION

There are several studies, showing strong relationship between microalbuminuria and essential hypertension.

In one study it was shown that, " prevalence of microalbuminuria among the essential hypertensives was 21.5% in hypertensives subject. Microalbuminuria was seen more in patients with severe disease and was significantly influenced by the disease duration."

In another study it was showed –"prevalence of microalbuminuria was 30% among essential hypertensives, with higher prevalence of vascular complications and longer duration of HTN in microalbuminurics."

Also "prevalence of microalbuminuria was 37.5% in patients with essential HTN and showed a positive correlation with the severity of HTN and thus may be an early marker for endorgan damage susceptibility."39.

In a study, it has shown " microalbuminuria is an early marker of preclinical brain damage in essential HTN and may therefore be useful for identifying patients as high risk for cerebral and cardiovascular events, for whom preventive therapeutic measures are advisable."

In a study "the systolic BP, mean arterial BP and pulse pressure values were significantly higher in the microalbuminuric than the normoalbuminuric hypertensive cases."

"Hypertensive with increased microalbumin in urine manifest a variety of derangements with pathogenic potential, which results in greater incidence of cardiovascular events and deterioration of renal function than patients with normal urinary albumin excretion."

"Microalbuminuric hypertensive patients showed signs of early target organ damage as compared to normoalbuminuric hypertensive patients and normal subjects, namely grater left ventricular mass indices and increased wall thickness of common carotid arteries as well as higher intra renal vascular resistance."40

In a study it has showed "that more number of patients with microalbuminuria with essential hypertension had LVH (42.3%Vs.12.2%), severe hypertensive retinopathy (30.8%Vs 4.1%) and renal insufficiency (30.6%vs 0%) as compared to patients without elevated proteinuria."**41**

In another study it has showed "that prevalence of increased Intima Media thickness was more among subjects with microalbuminuria when compared to subject with normoalbuminuria and also VWF concentrations were higher in hypertensives patients with microalbuminuria than without."

"Elevated UAE has been found to be a predictor of cardiovascular disease and an increased susceptibility/vulnerability to end – organ

damage, among the essential hypertensives.**42** and also that proteinuria among essential hypertensives appears to reflect widespread vascular damage.

In a study, it has showed "that microalbuminuria has been associated with cluster of metabolic and non- metabolic risk factors, suggesting that it might indicated the presence of generalized microvascular damage in patients with essential hypertension."

"Hypertensives with microalbuminuria manifest greater levels of blood pressure, particularly at night, and higher serum levels of cholesterol, triglycerides, and uric acid than patients with normal urinary albumin excretion."

Red cell distribution width (RDW)

It is measurement of the variation present in red blood cell size or its volume. RDW is elevated when there is increase in variation of red cell size (anisocytosis), ie, when elevated RDW is present , marked anisocytosis (increased variation in red cell size) is expected to be present on peripheral blood smear .

RDW reference range is as follows:

RDW-SD 39-46 fL

RDW-CV 11.6-14.6% in adult

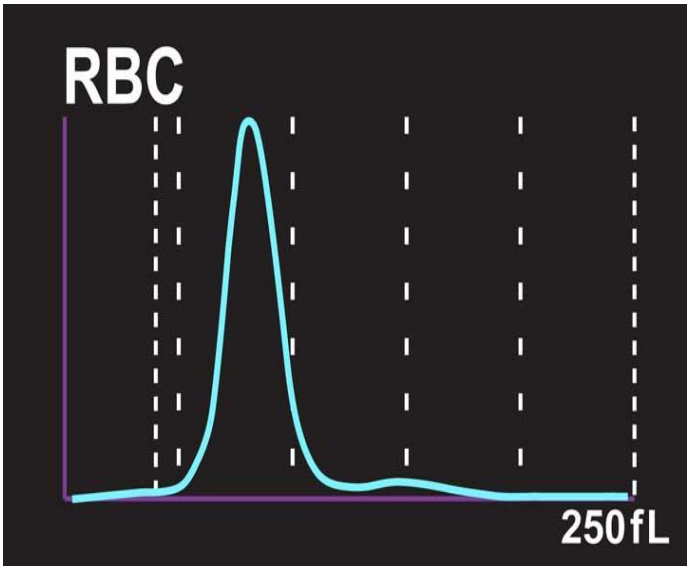
Reference ranges may vary depending on the individual laboratory and patient's age.

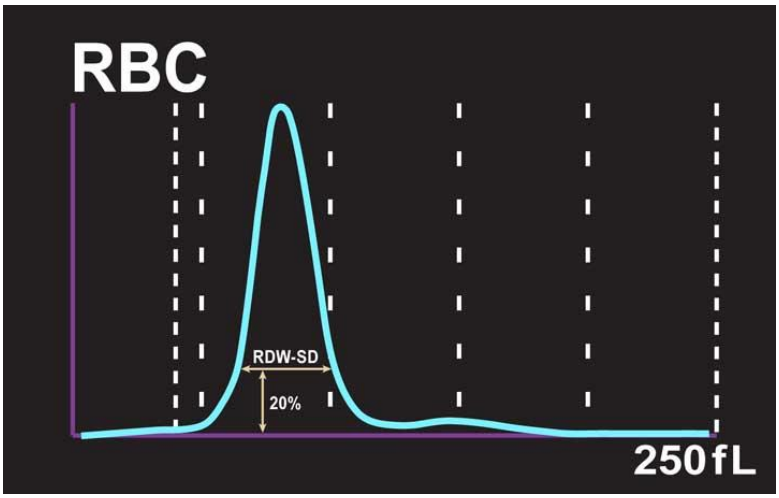
Red cell distribution width (RDW) measures variability of red cell volume/size (anisocytosis). Depending on the types of hematology analyzer instruments, RDW can be reported statistically as coefficient of variation (CV) and/or standard deviation (SD), RDW-CV and/or RDW-SD, respectively. RDW-SD (express in fL) is an actual measurement of the width of the RBC size distribution histogram (see the first image below) and is measured by calculating the width (in fL) at the 20% height level of the RBC size distribution histogram (see the second image below). This parameter is therefore not influenced by the average RBC size RDW-CV (express in %) is calculated from standard deviation and MCV as follows (see the third image below):

RDW-CV (%) = 1 standard deviation of RBC volume/MCV x 100%

Of note, since RDW-CV is mathematically derived from MCV, it is therefore affected by the average RBC size (MCV).

RED CELL DISTRIBUTION WIDTH HISTOGRAM





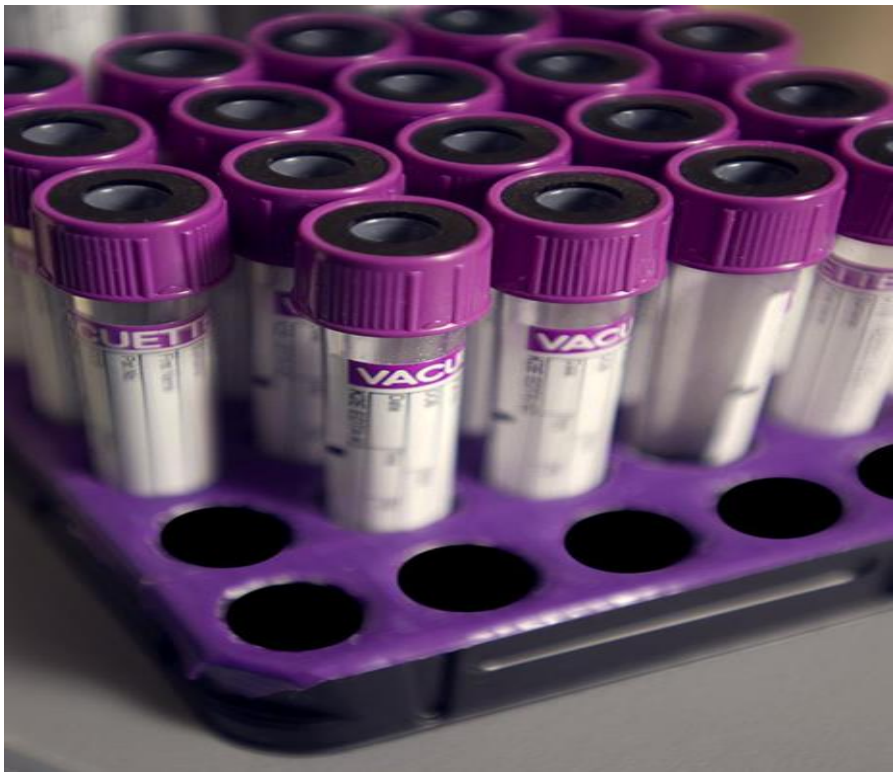
RED CELL DISTRIBUTION WIDTH STANDARD DEVIATION MEASUREMENT

Specimen:

Whole blood, usually collected by venipuncture

Collection:

EDTA tube (purple/lavender top) containing EDTA potassium salt additive as an anticoagulant (see image below)



METHODOLOGY

Patients with hypertension of varying durations coming to Royapettah Government Hospital were chosen as subjects For this study, during the period of April 2014 to September 2014.

Inclusion criteria:

Patients with essential hypertension coming to Government Royapettah Hospital

Table 2. Joint National Committee On Prevention, Detection, Evaluation, And Treatment Of High Blood Pressure (JNC 7).

Normal	< 120/80
Prehypertension	120-139/80-89
Hypertension	≥ 140/90
Stage 1	140-159/90-99
Stage 2	≥ 160/100

Exclusion criteria:

- Patients with severe anemia
- Patient with acute blood loss

A total of 50 patients were studied. All subjects were investigated in detailincluding history of symptoms and signs

suggestive of target organ damage, duration of hypertension, drug history, previous blood pressure recordings, complete urine analysis, complete blood count with Red Cell Distribution width, biochemistry (urea, creatinine, FBS), ECG, 24 hours urine for microalbuminuria estimation was done by Immune Turbidmetric assay. Red cell distribution width was measured using Auto Hematology Analyser

RESULTS

TABLE 1

CORRELATION BETWEEN RCDW AND MICROALBUMINRIA

RCDW	MICROALBUMINURIA PRESENT	ABSENT
11 – 13	1	18
13 – 15	24	7

TABLE 2

CORRELATION BETWEEN SYSTOLIC BLOOD PRESSURE AND MICROALBUMINURIA

MICROALBUMINURIA		
SYSTOLIC BLOOD PRESSURE	PRESENT	ABSENT
<120	2	9
120 – 139	2	8
140 – 159	12	5
>160	9	3

TABLE 3

CORRELATION BETWEEN DIASTOLIC BLOOD PRESSURE AND MICROALBUMINURIA

DIASTOLIC BLOOD PRESSURE IN MMHG	MICROALBUMINURIA	
	PRESENT	ABSENT
<80	4	15
>80	21	10

TABLE 4

CORRELATION BETWEEN MICROALBUMINURIA AND GENDER

SEX	MICROALBUMINURIA	
	PRESENT	ABSENT
MALE	16	20
FEMALE	9	5

TABLE 5

CORRELATION BETWEEN MICROALBUMINURIA AND AGE

AGE yrs	MICROALBUMINURIA	
	PRESENT	ABSENT
<50	3	13
51 – 60	8	4
61 – 70	10	7
>70	4	1

TABLE 6

CORRELATION BETWEEN MICROALBUMINURIA AND HEMOGLOBIN

HEMOGLOBIN IN GM%	MICROALBUMINURIA	
	PRESENT	ABSENT
<11	1	2
11 – 13	8	6
>13	16	17

TABLE 7

CORRELATION BETWEEN MICROALBUMINURIA AND FASTING BLOOD SUGAR

FASTING BLOOD SUGAR IN GM %	MICROALBUMINURIA	
	PRESENT	ABSENT
<=126	3	4
>126	22	21

TABLE 8

CORRELATION BETWEEN MICROALBUMINURIA AND LEFT VENTRICULAR HYPERTROPHY

ECG	MICROALBUMINURIA	
	PRESENT	ABSENT
NORMAL	18	23
LEFT VENTRICULAR HYPERTROPHY	7	2

TABLE 9

CORRELATION BETWEEN MICROALBUMINURIA AND TREATMENT COMPLIANCE

TREATMENT	MICROALBUMINURIA	
	PRESENT	ABSENT
REGULAR	8	20
IRREGULAR	17	5

TABLE 10

CORRELATION BETWEEN MICROALBUMINURIA AND DURATION OF HYPERTENSION IN YEARS

DURATION IN YEARS	MICROALBUMINURIA	
	PRESENT	ABSENT
<10	15	21
>10	10	4

TABLE 11

CORRELATION BETWEEN MICROALBUMINURIA AND CREATININE

CREATININE IN MG%	MICROALBUMINURIA	
	PRESENT	ABSENT
<=1	19	21
>1	6	4

TABLE 12

CORRELATION BETWEEN RED CELL DISTRIBUTION WIDTH AND DIASTOLIC BLOOD PRESSURE IN MM HG

DIASTOLIC BLOOD PRESSURE IN MM HG	RED CELL DISTRIBUTION WIDTH	
	11 – 12.99	13 – 15
<=80	11	8
>80	8	23

TABLE 13

CORRELATION BETWEEN RED CELL DISTRIBUTION WIDTH AND SYSTOLIC BLOOD PRESSURE IN MMHG

SYSTOLIC BLOOD PRESSURE IN MMHG	RED CELL DISTRIBUTION WIDTH	
	11 – 12.99	13 – 15
<120	8	3
121 – 140	5	5
141 – 160	4	13
>160	2	10

TABLE 14

CORRELATION BETWEEN RED CELL DISTRIBUTION WIDTH AND AGE

AGE IN YRS	RED CELL DISTRIBUTION WIDTH	
	11 - 12.99	13 – 15
<=50	12	4
51 – 60	3	9
61 – 70	4	13
>70	0	5

TABLE 15

CORRELATION BETWEEN RED CELL DISTRIBUTION WIDTH AND GENDER

SEX	RED CELL DISTRIBUTION WIDTH	
	11 – 12.99	13 – 15
MALE	15	21
FEMALE	4	10

TABLE 16

CORRELATION BETWEEN RED CELL DISTRIBUTION WIDTH AND HEMOGLOBIN

HEMOGLOBIN IN GM%	RED CELL DISTRIBUTION WIDTH	
	11 – 12.99	13 - 15
<11	1	2
11 -13	5	9
>13	13	20

TABLE 17

CORRELATION BETWEEN RED CELL DISTRIBUTIONS WIDTH AND FASTING BLOOD SUGAR

FASTING BLOOD SUGAR IN MG%	RED CELL DISTRIBUTION WIDTH	
	11 – 12.99	13 - 15
< =126	3	4
>126	16	27

TABLE 18

CORRELATION BETWEEN RED CELL DISTRIBUTION WIDTH AND LEFT VENTRICULAR HYPERTROPHY

ECG	RED CELL DISTRIBUTION WIDTH	
	11 – 12.99	13 - 15
NORMAL	18	23
LEFT VENTRICULAR HYPERTROPHY	1	8

TABLE 19

CORRELATION BETWEEN RED CELL DISTRIBUTION WIDTH AND TREATMENT COMPLIANCE

TREATMENT	RED CELL DISTRIBUTION WIDTH	
	11 – 12.99	**13 - 15**
REGULAR	14	14
IRREGULAR	5	17

TABLE 2O

CORRELATION BETWEEN RED CELL DISTRIBUTION WIDTH AND DURATION OF HYPERTENSION

DURATION INYEARS	RED CELL DISTRIBUTION WIDTH	
	11 – 12.99	**13 - 15**
<10	17	19
>10	2	12

TABLE 21

CORRELATION BETWEEN RED CELL DISTRIBUTION WIDTH AND SERUM CREATININE

SERUM CREATININE IN MG%	RED CELL DISTRIBUTION WIDTH	
	11 – 12.99	13 - 15
<=1	16	24
>1	3	7

STATISTICAL ANALYSIS

TABLE 22

			Microalbuminuria		Total	P value
			Present	Absent		
RCDW	11-13	Count	1	18	19	<0.001**
		% within RCDW	5.3%	94.7%	100.0%	
		% within Microalbuminuria	4.0%	72.0%	38.0%	
	13-15	Count	24	7	31	
		% within RCDW	77.4%	22.6%	100.0%	
		% within Microalbuminuria	96.0%	28.0%	62.0%	
Total		Count	25	25	50	
		% within RCDW	50.0%	50.0%	100.0%	
		% within Microalbuminuria	100.0%	100.0%	100.0%	

INFERENCE

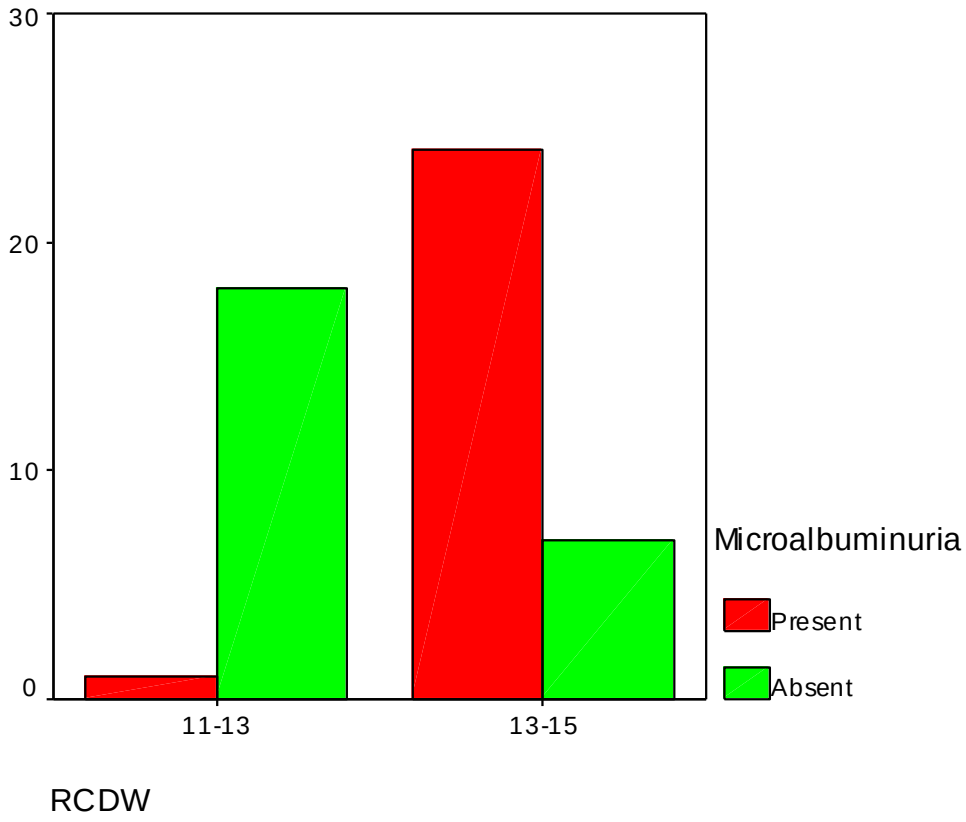
Out of 50 patients 25 patients had microalbuminuria [50%], among them 24 persons had rcdw more than 13 [96%].

Among the 25 patients without microalbuminuria 7 persons had rcdw more than 13.

1 person with microalbuminuria had rcdw less than 13.

18 patients had rcdw <13 and no microalbuminuria.

The association between rcdw and microalbuminuria among hypertensive patients is found to be significant with p value of <0.001%


30
20
10
0
11-13
13-15
RCDW
Microalbuminuria
Present
Absent

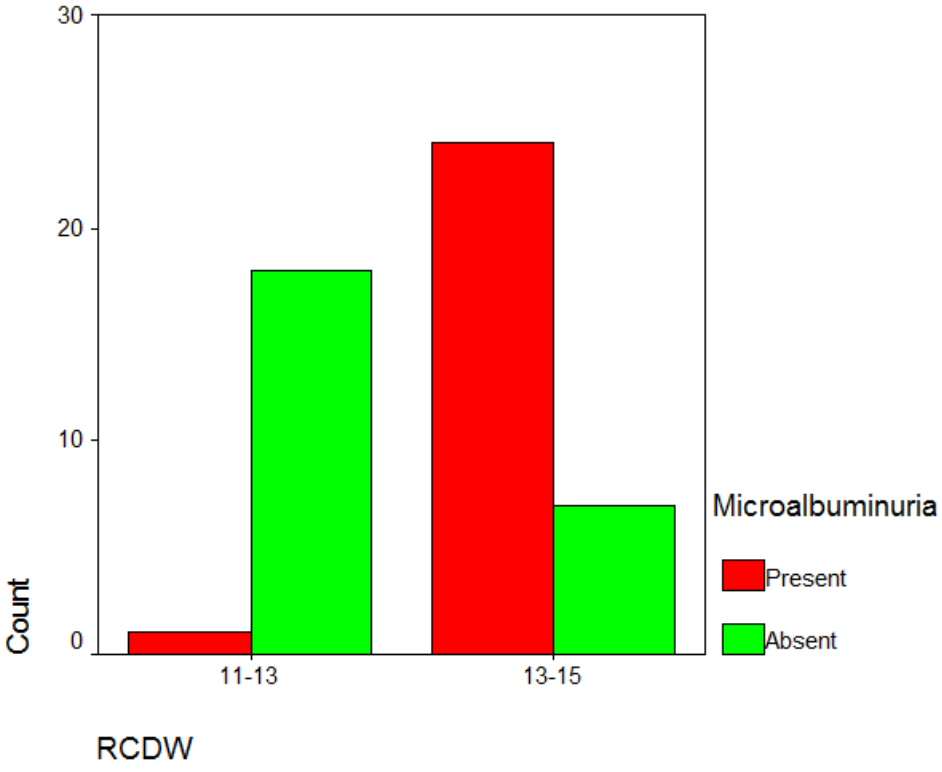

30
20
10
0
Count
11-13
13-15
RCDW
Microalbuminuria
Present
Absent

TABLE 23

			Microalbuminuria		
			Present	Absent	Total
SBP	<= 120	Count	2	9	11
		% within SBP	18.2%	81.8%	100.0%
		% within Microalbuminuria	8.0%	36.0%	22.0%
	121-140	Count	2	8	10
		% within SBP	20.0%	80.0%	100.0%
		% within Microalbuminuria	8.0%	32.0%	20.0%
	141-160	Count	12	5	17
		% within SBP	70.6%	29.4%	100.0%
		% within Microalbuminuria	48.0%	20.0%	34.0%
	> 160	Count	9	3	12
		% within SBP	75.0%	25.0%	100.0%
		% within Microalbuminuria	36.0%	12.0%	24.0%
Total		Count	25	25	50
		% within SBP	50.0%	50.0%	100.0%
		% within Microalbuminuria	100.0%	100.0%	100.0%

Out of 11 patients with systolic blood pressure less than 120 mm of hg 2 persons had microalbuminaria

Among the 10 patiens with systolic blood pressure between 121 and 140 mm of hg 2 persons had microalbuminuria 17 patients had systolic blood pressure between 141 and 160 mm 0f hg among them 12 patients had microalbuminuria

9 patients among the 12 showing systolic blood pressure above 160 mm of hg had microalbuminuria

The association between the level of increase in systolic blood pressure and microalbuminuria was found to be not statistically significant with p value >0.001.

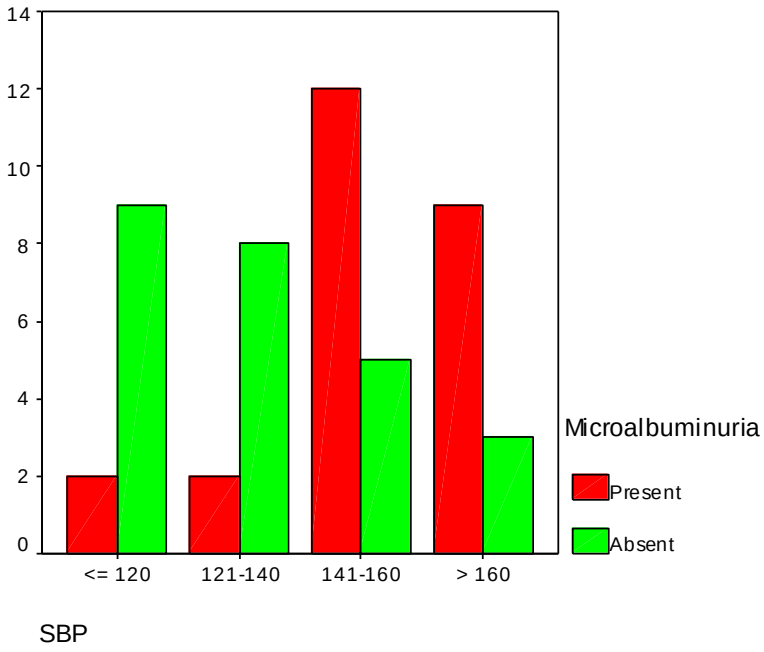


TABLE 24

			RCDW		
			11-12.99	13-15	Total
SBP	<120	Count	8	3	11
		% within SBP	72.7%	27.3%	100.0%
		% within RCDW	42.1%	9.7%	22.0%
	120-139	Count	5	5	10
		% within SBP	50.0%	50.0%	100.0%
		% within RCDW	26.3%	16.1%	20.0%
	140-159	Count	4	13	17
		% within SBP	23.5%	76.5%	100.0%
		% within RCDW	21.1%	41.9%	34.0%
	> 160	Count	2	10	12
		% within SBP	16.7%	83.3%	100.0%
		% within RCDW	10.5%	32.3%	24.0%
Total		Count	19	31	50
		% within SBP	38.0%	62.0%	100.0%
		% within RCDW	100.0%	100.0%	100.0%

Out of 11 patients with systolic blood pressure less than 120 mm of hg 3 persons [27.3 %] had red cell distribution width more than 13.

Among the 10 persons having systolic blood pressure between 120 and 139 mm of hg 5 patients [50%] had red cell distribution width more than 13.

Of the 17 persons having systolic blood pressure between 140 and 159 mm of hg , 13 persons[76.5%] had red cell distribution width more than 13.

10 persons [83.3%] among the 12 persons showing systolic blood pressure more than 160 mm of hg had red cell distribution width more than 13.

The association between elevation of systolic blood pressure and the increase in red cell distribution width was found to be stastically significant with p value of <0.001 .

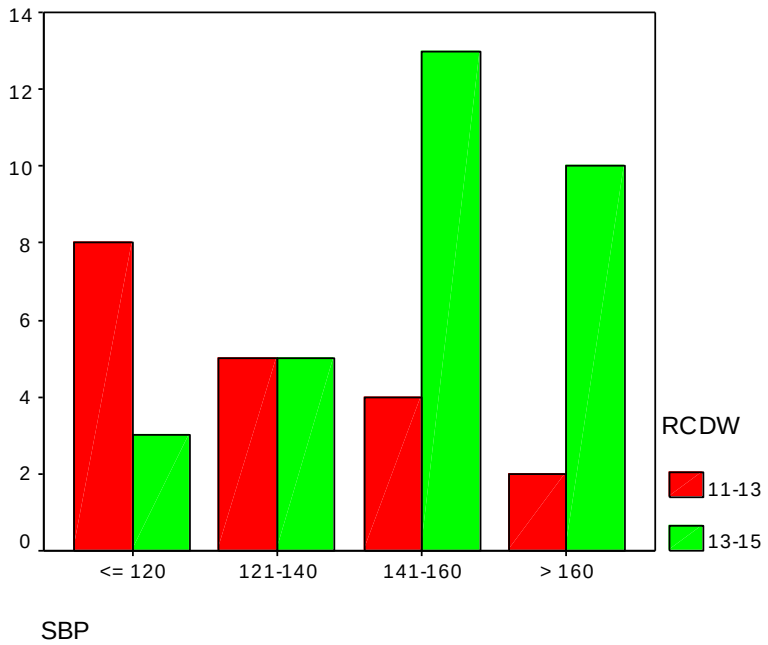
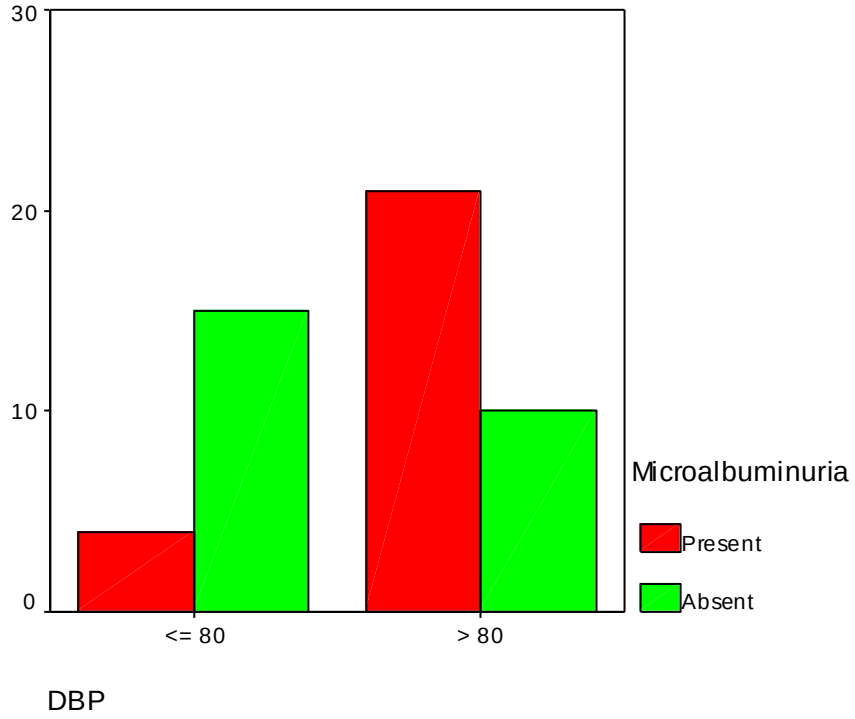


TABLE 25

			Microalbuminuria		
			Present	Absent	Total
DBP	<= 80	Count	4	15	19
		% within DBP	21.1%	78.9%	100.0%
		% within Microalbuminuria	16.0%	60.0%	38.0%
	> 80	Count	21	10	31
		% within DBP	67.7%	32.3%	100.0%
		% within Microalbuminuria	84.0%	40.0%	62.0%
Total		Count	25	25	50
		% within DBP	50.0%	50.0%	100.0%
		% within Microalbuminuria	100.0%	100.0%	100.0%



Out of the 25 patients having microalbuminuria 21 persons [84%] had diastolic blood pressure more than 80 mm of hg.

Among the 31 persons having diastolic blood pressure more than 80 mm of hg, 21 persons [67.7%] had microalbuminuria.

Among the 19 patients having diastolic blood pressure less than 80 mm of hg 4 patients [21.1%] had microalbuminuria.

The Association Between Increase In Diastolic Blood Pressure And Microalbuminuria Was Found To Be Stasticaly Significant With P Value < 0.001.

TABLE 26

			RCDW		
			11-13	13-15	Total
DBP	<= 80	Count	11	8	19
		% within DBP	57.9%	42.1%	100.0%
		% within RCDW	57.9%	25.8%	38.0%
	> 80	Count	8	23	31
		% within DBP	25.8%	74.2%	100.0%
		% within RCDW	42.1%	74.2%	62.0%
Total		Count	19	31	50
		% within DBP	38.0%	62.0%	100.0%
		% within RCDW	100.0%	100.0%	100.0%

Out of the 31 patients having diastolic blood pressure of more than 80 mm of hg 23 persons [74.2%] had red cell distribution width of >13.

Among the 19 persons having diastolic blood pressure of less than 80 mm of hg 8 persons [42.1%] had red cell distribution width ofmore than 13.

1 patients having red cell distribution width more than 13 , 23 persons [74.2%] had diastolic blood pressure more than 80 mm of hg.

The association between increase in red cell distribution width and increase in diastolic blood pressure was found to be stastically significant with p value of <0.001

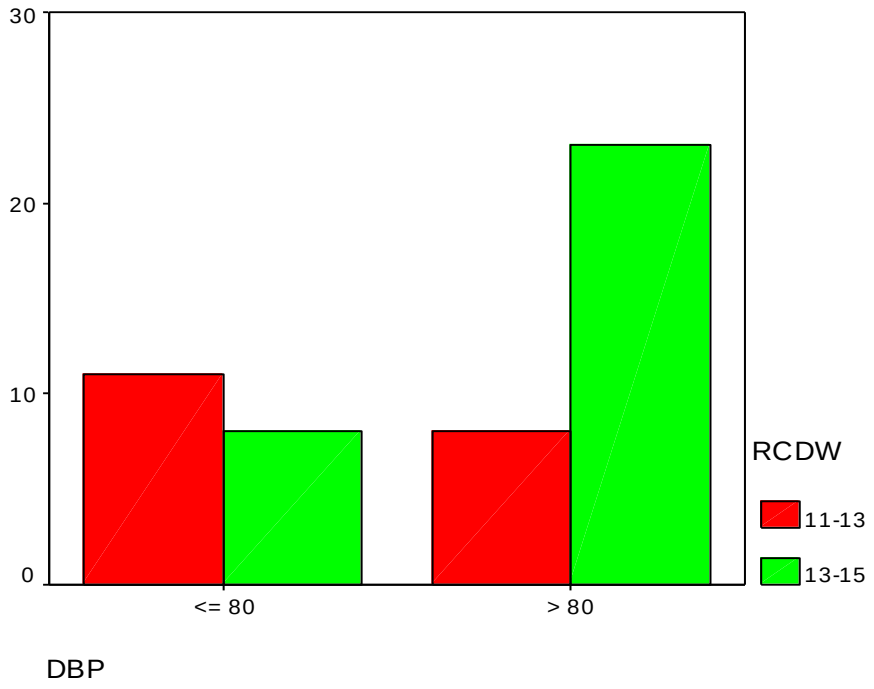
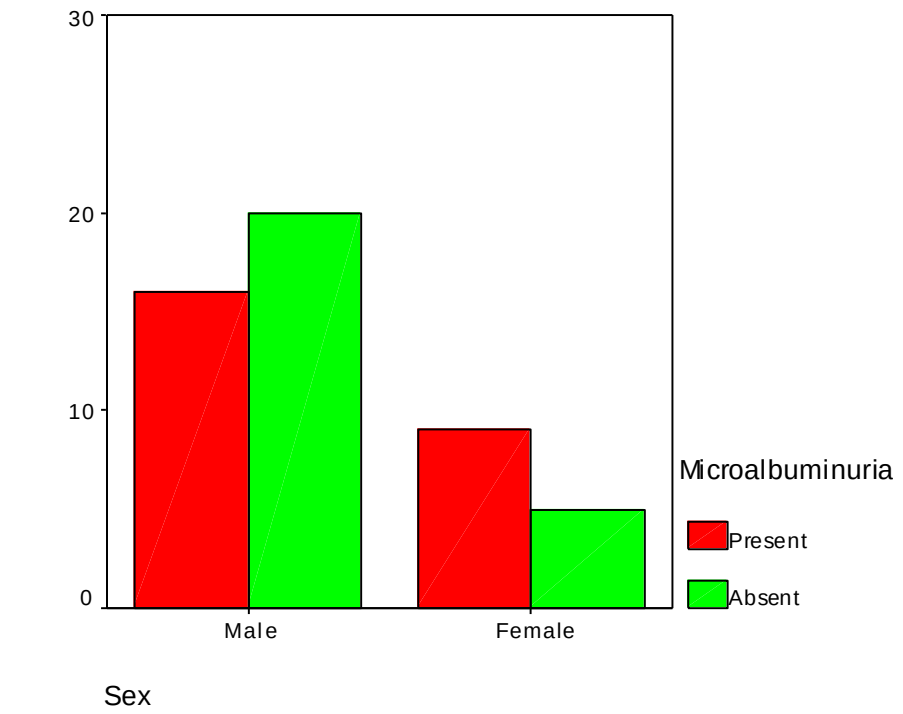
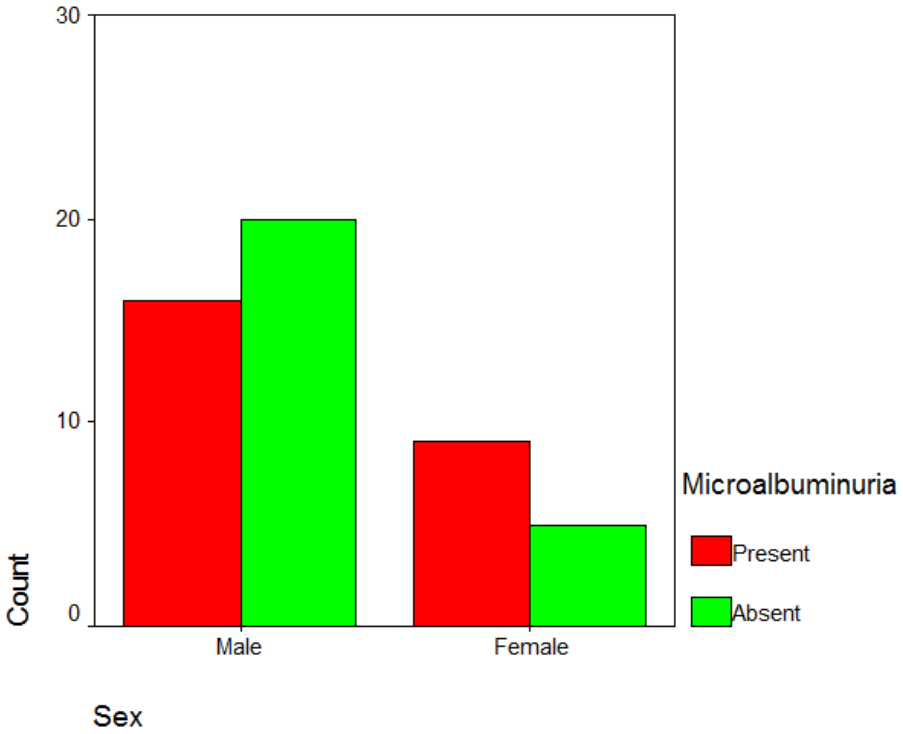


TABLE 27

CORRELATION BETWEEN GENDER AND MICROALBUMINURIA

			Microalbuminuria		Total
			Present	Absent	
Sex	Male	Count	16	20	36
		% within Sex	44.4%	55.6%	100.0%
		% within Microalbuminuria	64.0%	80.0%	72.0%
	Female	Count	9	5	14
		% within Sex	64.3%	35.7%	100.0%
		% within Microalbuminuria	36.0%	20.0%	28.0%
Total		Count	25	25	50
		% within Sex	50.0%	50.0%	100.0%
		% within Microalbuminuria	100.0%	100.0%	100.0%

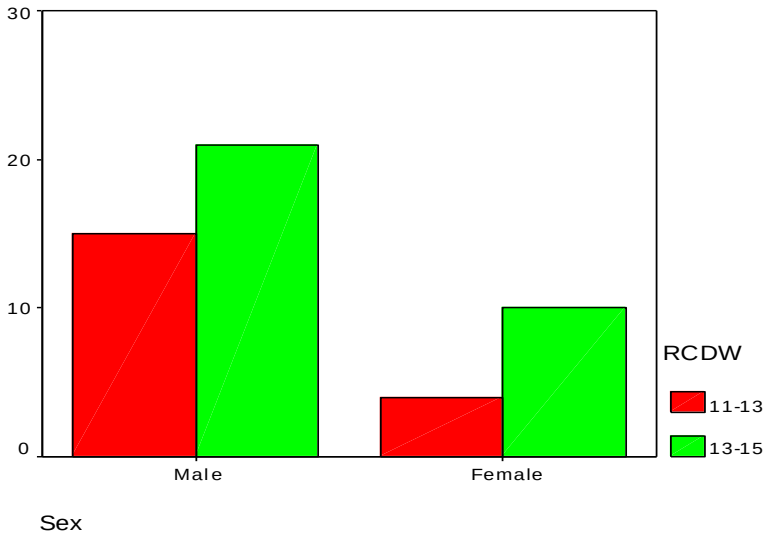




Out of the 25 patients having microalbuminuria 16 persons [64%] were males. And 9 patients [36%] were females.

TABLE 28

			RCDW		Total
			11-13	13-15	
Sex	Male	Count	15	21	36
		% within Sex	41.7%	58.3%	100.0%
		% within RCDW	78.9%	67.7%	72.0%
	Female	Count	4	10	14
		% within Sex	28.6%	71.4%	100.0%
		% within RCDW	21.1%	32.3%	28.0%
Total		Count	19	31	50
		% within Sex	38.0%	62.0%	100.0%
		% within RCDW	100.0%	100.0%	100.0%



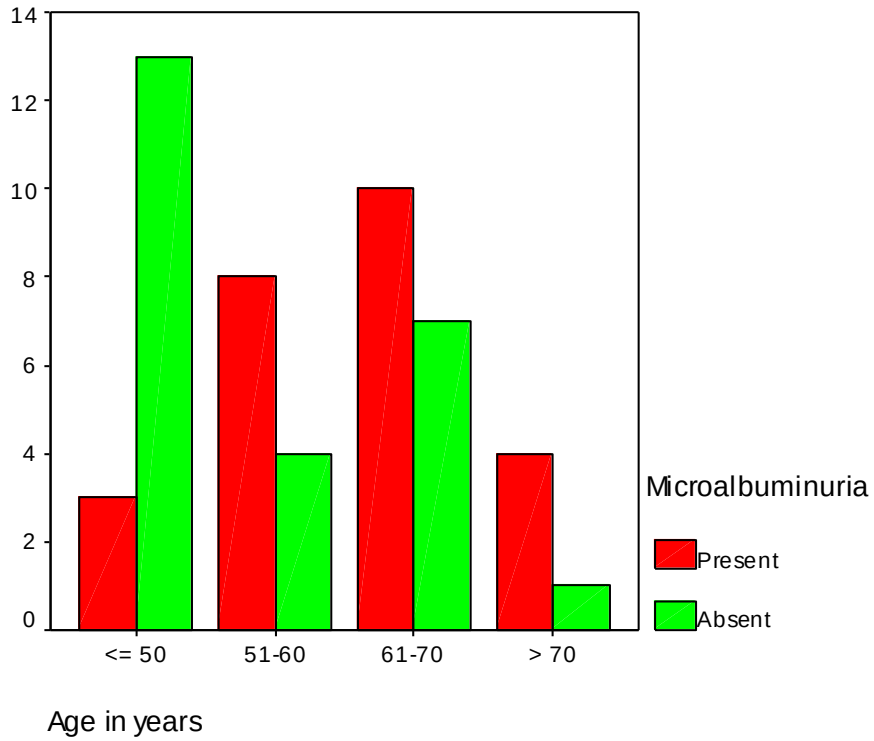
Out Of 31 Patients Having Red Cell Distribution Width Above 13, 21 [67.7]Were Male And 10 [32.3]Were Female

TABLE 29

			Microalbuminuria		Total
			Present	Absent	
Age in years	<= 50	Count	3	13	16
		% within Age in years	18.8%	81.3%	100.0%
		% within Microalbuminuria	12.0%	52.0%	32.0%
	51-60	Count	8	4	12
		% within Age in years	66.7%	33.3%	100.0%
		% within Microalbuminuria	32.0%	16.0%	24.0%
	61-70	Count	10	7	17
		% within Age in years	58.8%	41.2%	100.0%
		% within Microalbuminuria	40.0%	28.0%	34.0%
	> 70	Count	4	1	5
		% within Age in years	80.0%	20.0%	100.0%
		% within Microalbuminuria	16.0%	4.0%	10.0%
Total		Count	25	25	50
		% within Age in years	50.0%	50.0%	100.0%
		% within Microalbuminuria	100.0%	100.0%	100.0%

Out of the 28 persons under 60 years 11 persons had microalbuminuria.

Out of 22 persons above 60 years 14 had microalbuminuria.



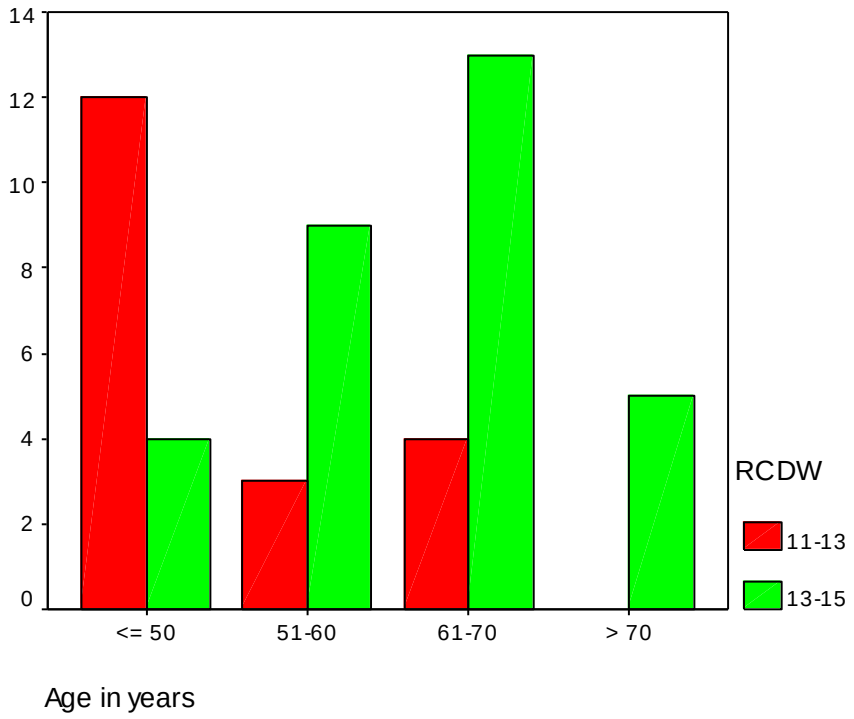
Bar Diagram Showing Correlation Between Age And Microalbuminuria

TABLE 30

			RCDW		
			11-13	13-15	Total
Age in years	<= 50	Count	12	4	16
		% within Age in years	75.0%	25.0%	100.0%
		% within RCDW	63.2%	12.9%	32.0%
	51-60	Count	3	9	12
		% within Age in years	25.0%	75.0%	100.0%
		% within RCDW	15.8%	29.0%	24.0%
	61-70	Count	4	13	17
		% within Age in years	23.5%	76.5%	100.0%
		% within RCDW	21.1%	41.9%	34.0%
	> 70	Count	0	5	5
		% within Age in years	.0%	100.0%	100.0%
		% within RCDW	.0%	16.1%	10.0%
Total		Count	19	31	50
		% within Age in years	38.0%	62.0%	100.0%
		% within RCDW	100.0%	100.0%	100.0%

Out of the 28 persons having age less than 60 years ,13 persons had red cell distribution width more than 13.

Out of the 22 persons aged more than 60 years 18 persons had red cell distribution width more than 13.

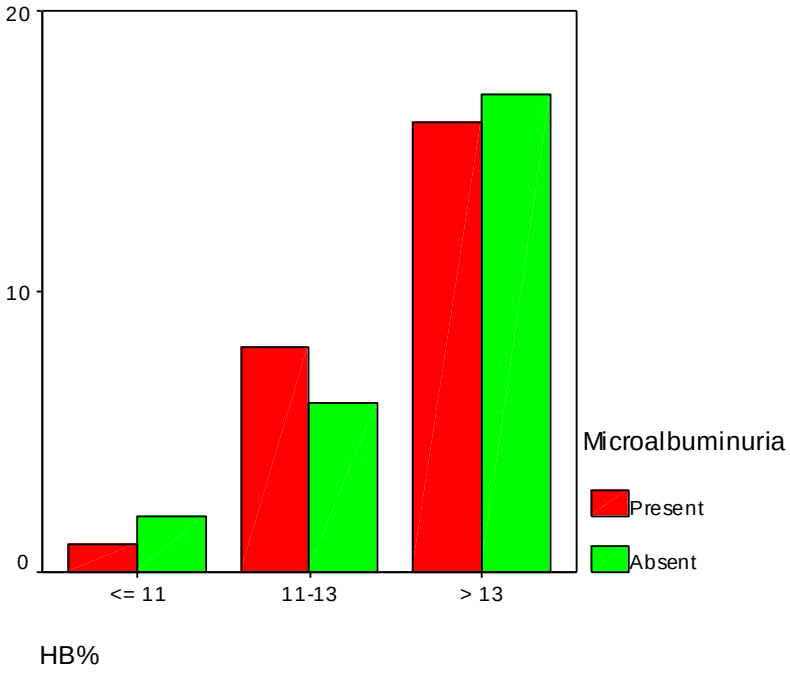


Bar Diagram Showing Correlation Between Age And Rcdw

TABLE 31

CORRELATION BETWEEN HB% AND MICROALBUMINURIA

			Microalbuminuria		
			Present	Absent	Total
HB%	<= 11	Count	1	2	3
		% within HB%	33.3%	66.7%	100.0%
		% within Microalbuminuria	4.0%	8.0%	6.0%
	11-13	Count	8	6	14
		% within HB%	57.1%	42.9%	100.0%
		% within Microalbuminuria	32.0%	24.0%	28.0%
	> 13	Count	16	17	33
		% within HB%	48.5%	51.5%	100.0%
		% within Microalbuminuria	64.0%	68.0%	66.0%
Total		Count	25	25	50
		% within HB%	50.0%	50.0%	100.0%
		% within Microalbuminuria	100.0%	100.0%	100.0%

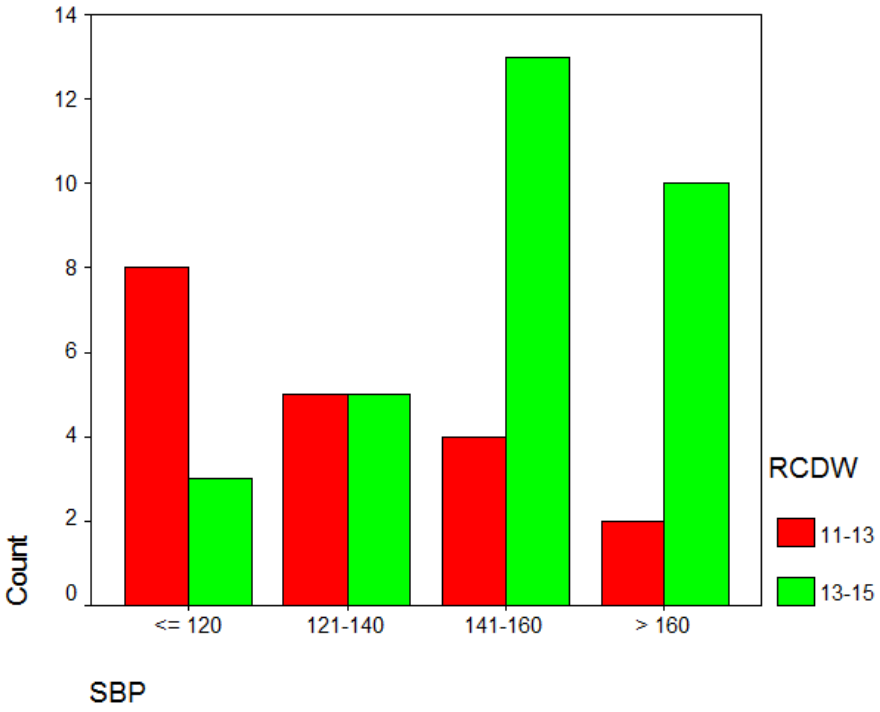


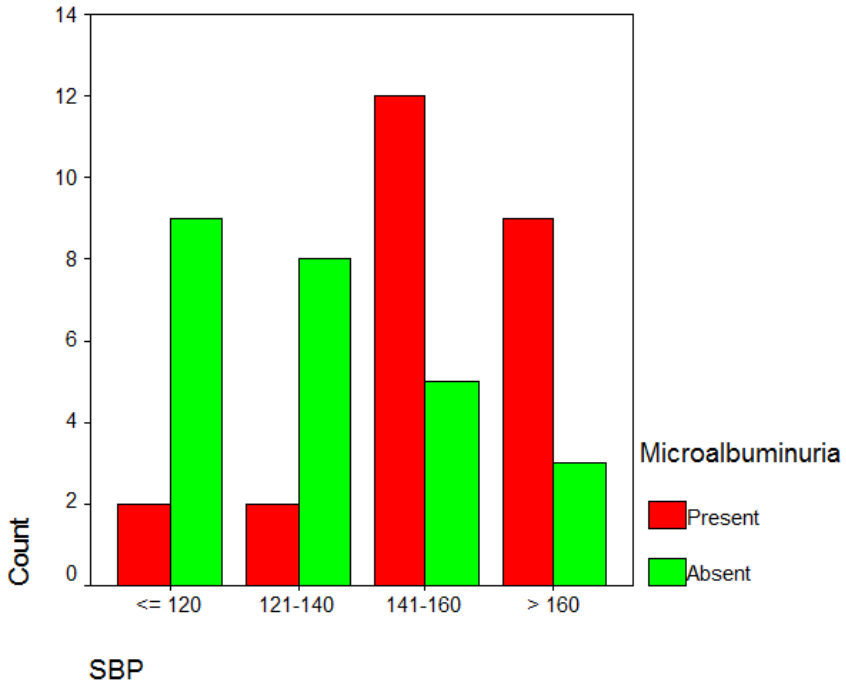
Out of the 25 patients having microalbuminuria 1 patient had hb% less than 11, 8 patients had hb% between 11 and 13, 16 Patients had hb% more than 13.

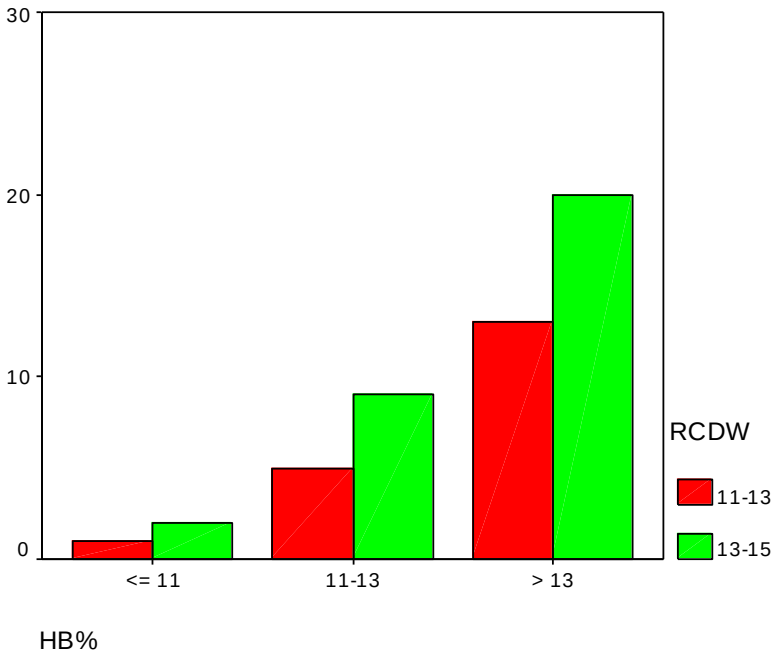
TABLE 32

CORRELATION BETWEEN HB% AND RCDW

			RCDW		Total
			11-13	13-15	
HB%	<= 11	Count	1	2	3
		% within HB%	33.3%	66.7%	100.0%
		% within RCDW	5.3%	6.5%	6.0%
	11-13	Count	5	9	14
		% within HB%	35.7%	64.3%	100.0%
		% within RCDW	26.3%	29.0%	28.0%
	> 13	Count	13	20	33
		% within HB%	39.4%	60.6%	100.0%
		% within RCDW	68.4%	64.5%	66.0%
Total		Count	19	31	50
		% within HB%	38.0%	62.0%	100.0%
		% within RCDW	100.0%	100.0%	100.0%


14
12
10
8
6
4
2
0
Count
<= 120
121-140
141-160
> 160
SBP
RCDW
11-13
13-15


14
12
10
8
6
4
2
0
Count
<= 120
121-140
141-160
> 160
SBP
Microalbuminuria
Present
Absent



Out of the 31 patients having red cell distribution width more than 13, 2 persons had hb% <11. 9 persons had hb% between 11 and 13. 20 persons had hb% >13.

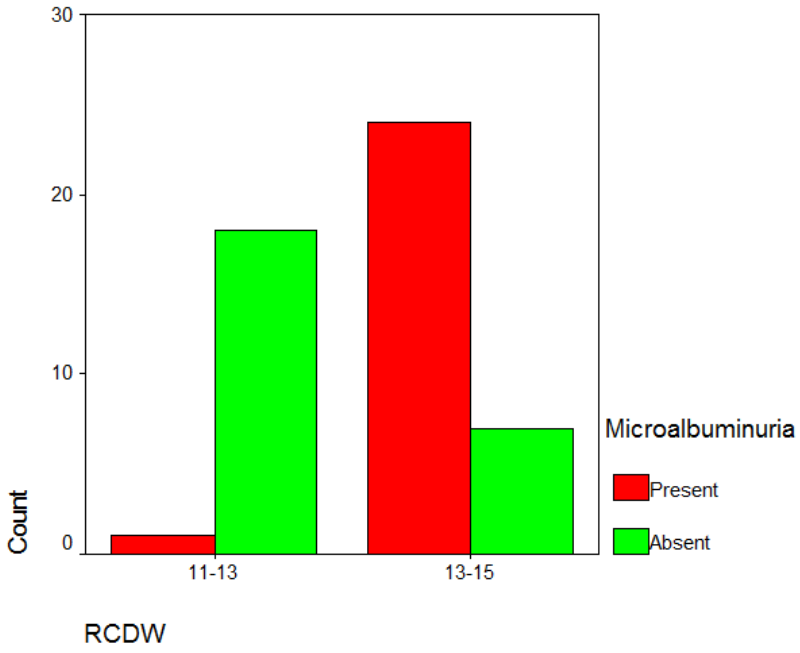
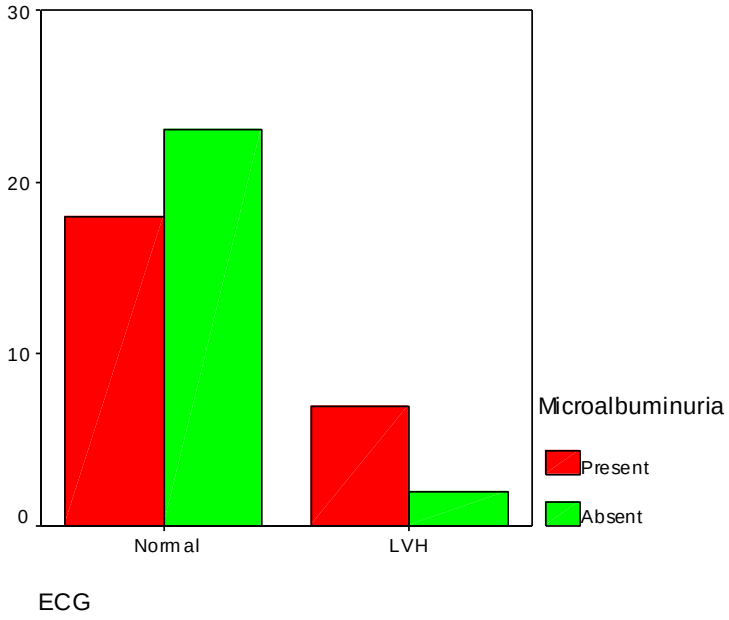


TABLE 33

			Microalbuminuria		Total
			Present	Absent	
ECG	Normal	Count	18	23	41
		% within ECG	43.9%	56.1%	100.0%
		% within Microalbuminuria	72.0%	92.0%	82.0%
	LVH	Count	7	2	9
		% within ECG	77.8%	22.2%	100.0%
		% within Microalbuminuria	28.0%	8.0%	18.0%
Total		Count	25	25	50
		% within ECG	50.0%	50.0%	100.0%
		% within Microalbuminuria	100.0%	100.0%	100.0%

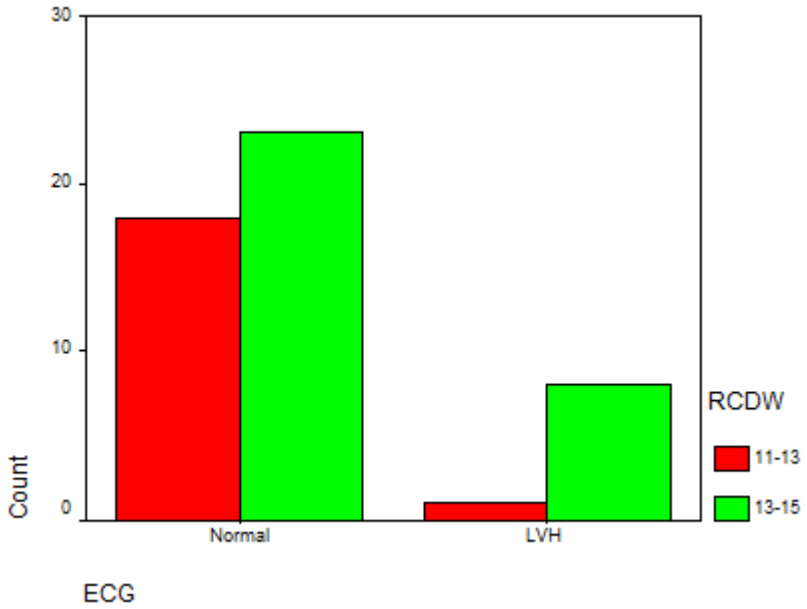
Out Of The 25 Patients Having Microalbuminuria 18 Had Normal Ecg And 7 Persons Had Left Ventricular Hypertrophy According To Sokolov Criteria



Out Of The 25 Patients Having Microalbuminuria 18 Had Normal Ecg And 7 Persons Had Left Ventricular Hypertrophy According To Sokolov Criteria

TABLE 34

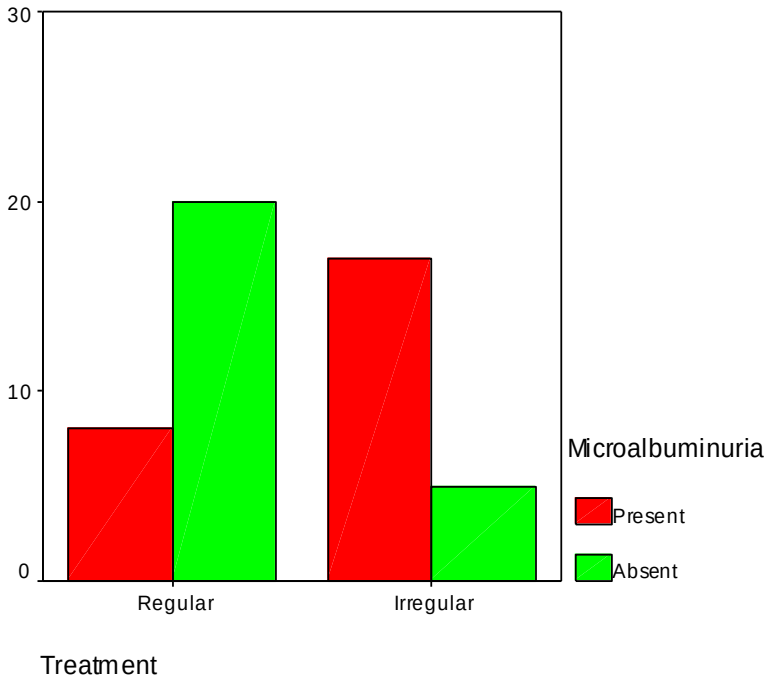
			RCDW		Total
			11-13	13-15	
ECG	Normal	Count	18	23	41
		% within ECG	43.9%	56.1%	100.0%
		% within RCDW	94.7%	74.2%	82.0%
	LVH	Count	1	8	9
		% within ECG	11.1%	88.9%	100.0%
		% within RCDW	5.3%	25.8%	18.0%
Total		Count	19	31	50
		% within ECG	38.0%	62.0%	100.0%
		% within RCDW	100.0%	100.0%	100.0%



Out of the 31 persons with red cell distribution width >13 , 23 had normal ecg, 8 persons had left ventricular hypertrophy.; out of 9 persons with left ventricular hypertrophy 8 had red cell distribution width >13.

TABLE 35

			Microalbuminuria		
			Present	Absent	Total
Treatment	Regular	Count	8	20	28
		% within Treatment	28.6%	71.4%	100.0%
		% within Microalbuminuria	32.0%	80.0%	56.0%
	Irregular	Count	17	5	22
		% within Treatment	77.3%	22.7%	100.0%
		% within Microalbuminuria	68.0%	20.0%	44.0%
Total		Count	25	25	50
		% within Treatment	50.0%	50.0%	100.0%
		% within Microalbuminuria	100.0%	100.0%	100.0%

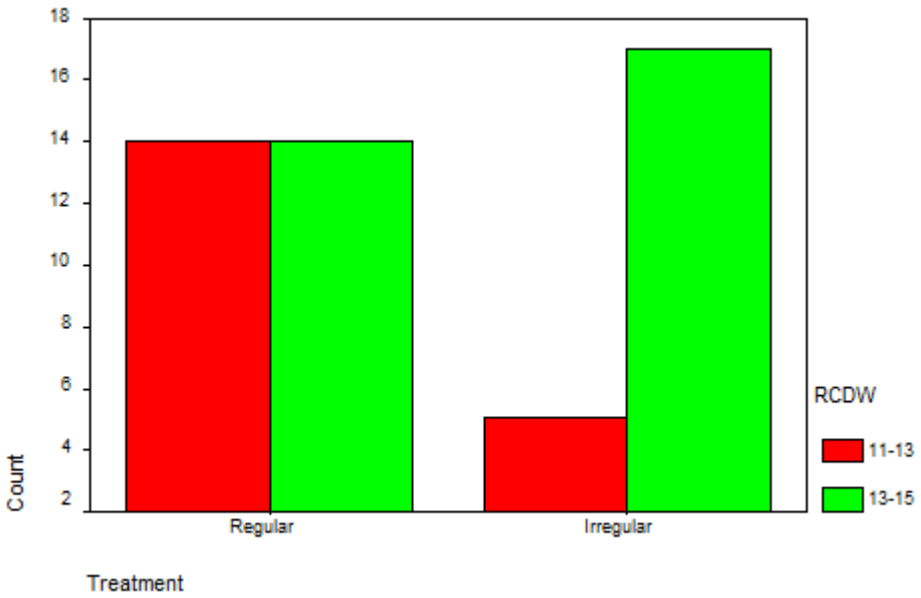


Out of the 25 persons with microalbuminuria 8 were in regular treatment and 17 were in irregular treatment.

Among 22 on irregular treatment 17 had microalbuminuria

TABLE 36

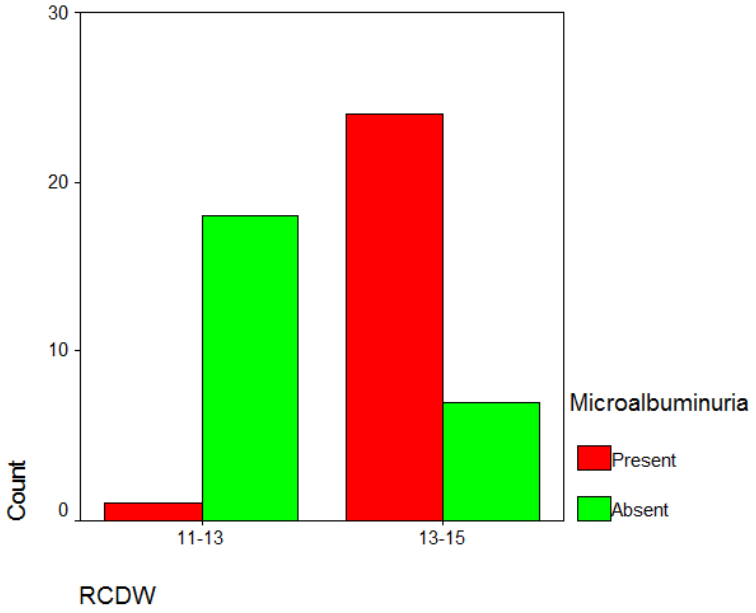
			RCDW		
			11-13	13-15	Total
Treatment	Regular	Count	14	14	28
		% within Treatment	50.0%	50.0%	100.0%
		% within RCDW	73.7%	45.2%	56.0%
	Irregular	Count	5	17	22
		% within Treatment	22.7%	77.3%	100.0%
		% within RCDW	26.3%	54.8%	44.0%
Total		Count	19	31	50
		% within Treatment	38.0%	62.0%	100.0%
		% within RCDW	100.0%	100.0%	100.0%



Out of the 31 patients with rcdw >13 , 14 were in regular treatment and 17 were in irregular treatment Among the 22 with irregular treatment , 17 had rcdw >13.

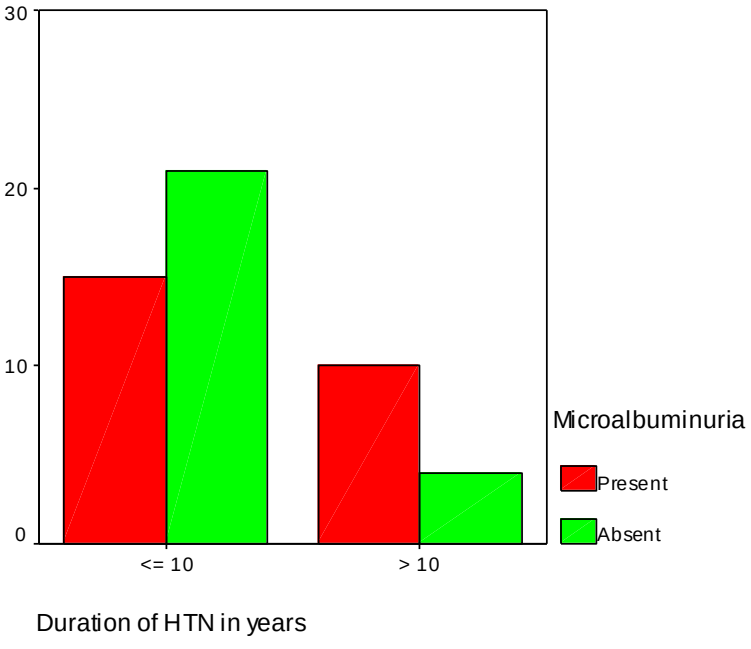
TABLE 37

			Microalbuminuria		
			Present	Absent	Total
Duration of HTN in years	<= 10	Count	15	21	36
		% within Duration of HTN in years	41.7%	58.3%	100.0%
		% within Microalbuminuria	60.0%	84.0%	72.0%
	> 10	Count	10	4	14
		% within Duration of HTN in years	71.4%	28.6%	100.0%
		% within Microalbuminuria	40.0%	16.0%	28.0%
Total		Count	25	25	50
		% within Duration of HTN in years	50.0%	50.0%	100.0%
		% within Microalbuminuria	100.0%	100.0%	100.0%



Out of the 25 persons with microalbuminuria, 15 persons had duration of hypertension <10 years, 10 had duration >10 years.

Out of the 14 patients with duration >10 years, 10 had microalbuminuria.



Out of the 25 persons with microalbuminuria, 15 persons had duration of hypertension <10 years, 10 had duration >10 years.

Out of the 14 patients with duration >10 years, 10 had microalbuminuria.

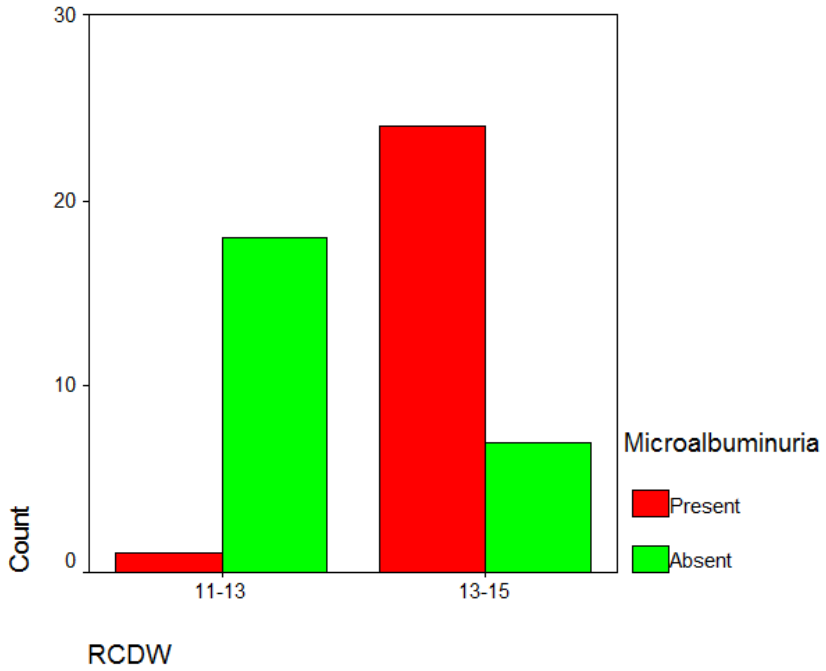
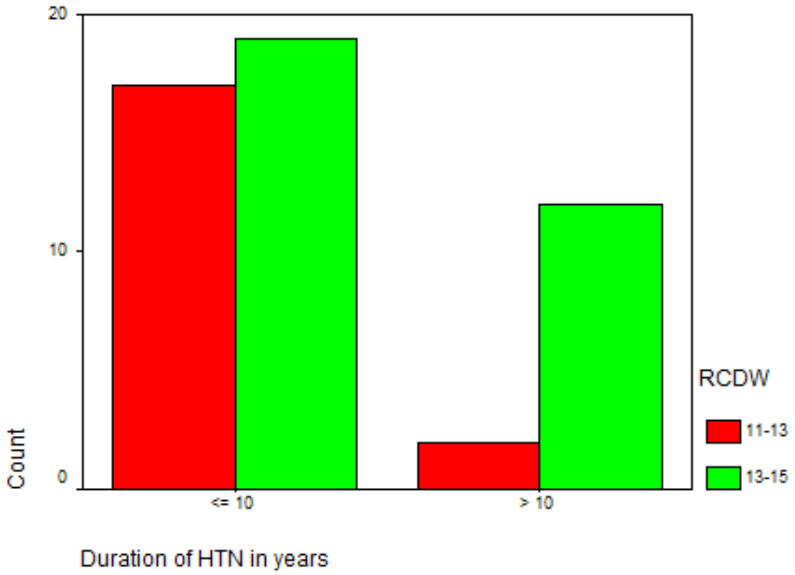


TABLE 38

			RCDW		
			11-13	13-15	Total
Duration of HTN in years	<= 10	Count	17	19	36
		% within Duration of HTN in years	47.2%	52.8%	100.0%
		% within RCDW	89.5%	61.3%	72.0%
	> 10	Count	2	12	14
		% within Duration of HTN in years	14.3%	85.7%	100.0%
		% within RCDW	10.5%	38.7%	28.0%
Total		Count	19	31	50
		% within Duration of HTN in years	38.0%	62.0%	100.0%
		% within RCDW	100.0%	100.0%	100.0%



Out Of The 31 Patients With Rcdw >13, 19 Persons Had Duration Of Hypertension< 10 Years, And 12 Had Duration Of Hypertension >10 Years.Among The 12persons With Duratioan >1o Years,10 Had Rcdw >13

DISCUSSION

Hypertension one of the major non communicable disease affecting a large population worldwide has been the subject of various studies conducted over the past several years. Renal involvement and cardio vascular involvement in hypertension are the important causes of greater morbidity and mortality .hypertension can cause damage to the blood vessels leading to endothelial dydfunction . Vascular and endothelial damage in the kidneys causes derangement of glomerular filtration resulting in renal injury at a early stage in the course of the disease. Dysfunction of the blood vessels in kidneys leads to disruption of normal renal filtration leading to microalbuminuria which progresses to chronic kidney disease.

A large number of studies have been conducted throughout the world to find a better marker for the early detection of renal involvement, which is also cost effective and reliable.

Red cell distribution width is a hemotological index that is routinely reported in automatic hematological analysers. a study by lippi et al reported an inverse association between rcdw and kidney function test. Previous studies have shown a strong association between red cell distribution width and mortality risk in patients having critical illness.

In the present study attempt was made to correlate between red cell distribution width and microalbuminuria as markers of renal involvement in hypertension.

Screening for microalbuminuria is both easy and also not expensive test for renal damage in hypertension. Urinary excretion of albumin had to be measured as a screening test in all hypertensive patients and if microalbuminuria is detected then intensive treatment is necessary for obtaining the necessary blood pressure control. Controlling of blood pressure reduces microalbuminuria and prevents the progression of renal involvement in hypertension.

A study by alphonso et al shows a correlation between red cell distribution width and renal involvement in cardiovascular disease.

In this study it was found that there was a statistically significant correlation between red cell distribution width and microalbuminuria in hypertensive patients [p value<0.001].in other words there was a higher likelihood of a hypertensive patients with microalbuminuria to have an elevated red cell distribution width.

The co relation between microalbuminuria and blood pressure was significant with increase in both systolic blood pressure [p =0.003] and increase in diastolic blood pressure[p=0.001].

The co relation between red cell distribution width and blood pressure was significant with increase in systolic blood pressure [p=0.002]. but not with diastolic blood pressure[p>0.01].

There is also a positive co relation between microalbuminuria and duration of hypertension [p=0.003].but there was no statistically significant correlation between red cell distribution width and duration of hypertension [p>0.01].

There is also a statistically significant correlation between compliance with anti hypertensive treatment and red cell distribution width ,with red cell distribution width being higher in patients on irregular treatment[p=0.003].

Attempt to co relate red cell distribution width raise and microalbuminuria with other parameters like left ventricular hypertrophy, gender variation, hemoglobin concentration and age was done but showed no statistically significant correlation.

In this study a definite correlation between increase in red cell distribution width and microalbuminuria in hypertensive patients was observed. Hence red cell distribution width level may serve as a potential marker of renal involvement and endothelial dysfunction in hypertensive patients. But considering the smaller size of the study further studies on larger population is necessary to make conclusive statements.

LIMITATIONS OF THE STUDY

A larger study population will be required before making any conclusive statements.

Healthy controls were not used in this particular study

CONCLUSION

The increase in red cell distribution width with increase in blood pressure correlated with microalbuminuria in hypertensive patients.

The correlation between increase in red cell distribution width and increase in blood pressure was more significant with systolic blood pressure elevation.

Age, gender, hemoglobin concentration, duration of hypertension did not show correlation between red cell distribution width and microalbuminuria in these hypertensive patients.

Microalbuminuria is more common in patients with long standing disease.

Red cell distribution width is higher in patients with poor treatment compliance.

LIST OF ABBREVIATIONS USED

ACE	Angiotensine converting enzyme
Bp	Blood pressure
CNS	Central nervous system
CT	Computer tomography
DBP	Diastolic blood pressure
DEH	Duration of Essential hypertension
ECG	Electrocardiography
ECHO	Echocardiography
FBS	Fasting blood sugar
H/o	History of
HDL	High density lipoprotein

HTN	Hypertension
IHD	Ischemic heart disease
JGA	Juxta glomerular apparatus
JNC	Joint National Committee
LVH	Left ventricular hypertrophy
Nacl	Sodiumchloride
NIDDM	Non insulin dependent diabetes mellitus
NS	Non significant
O_2	Oxygen
SBP	Systolic blood pressure
Sr.Cr	Serum creatinine
TC	Total cholesterol
TIA	Transient ischemic attack
TSH	Thyroid stimulating hormone
UAE	Urinary albumin excretion
UK	United kingdom
VWL	Von Willebrand factors
WBC	White Blood Cell
RCDW	Red Cell Distribution Width

PROFORMA

NAME:

AGE:

SEX:

ADDRESS: Op No:

D.O.A D.O.D DURATION OF HOSPITAL STAY

HISTORY AND PAST HISTORY:

PERSONAL HISTORY:

TREATMENT HISTORY:

GENERAL EXAMINATION: Built: Pallor:

Icterus:

Pedal oedema: Temp: Hydration:

Clubbing: PR: BP:

CVS:

RS :

PER ABDOMEN:

CNS:

INVESTIGATIONS

Complete haemogram including Red Cell Distribution Width

Fasting blood sugar

Serum Urea

Serum Creatinine

Triglyceride level

Urine:

Spot PCR for Microalbuminuria

ECG

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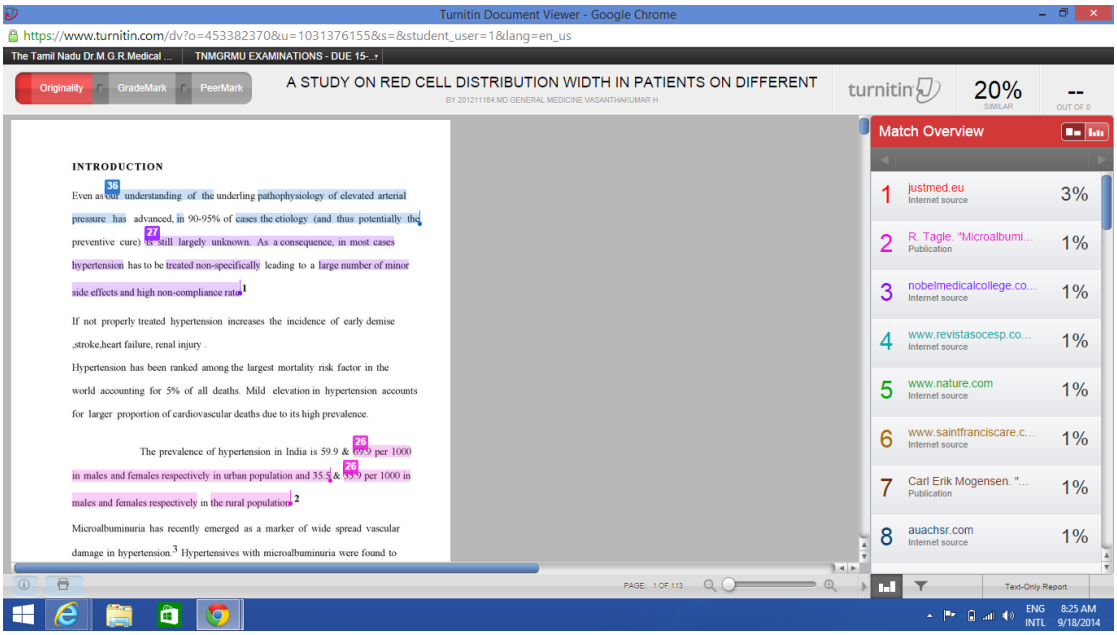
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INTRODUCTION
Even as our understanding of the underling pathophysiology of elevated arterial pressure has advanced, in 90-95% of cases the etiology (and thus potentially the preventive cure) is still largely unknown. As a consequence, in most cases hypertension has to be treated non-specifically leading to a large number of minor side effects and high non-compliance rate.[1]
If not properly treated hypertension increases the incidence of early demise ,stroke,heart failure, renal injury .
Hypertension has been ranked among the largest mortality risk factor in the world accounting for 5% of all deaths. Mild elevation in hypertension accounts for larger proportion of cardiovascular deaths due to its high prevalence.
The prevalence of hypertension in India is 59.9 & 69.9 per 1000 in males and females respectively in urban population and 35.5 & 39.9 per 1000 in males and females respectively in the rural population.[2]
Microalbuminuria has recently emerged as a marker of wide spread vascular damage in hypertension.[3] Hypertensives with microalbuminuria were found to
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NAME	AGE	SEX	IP/OP	Duration of HTN	HT	PULSE RATE	TEMPERATURE	WT	SBP	DBP	HB%	RCDW	SUGAR	UREA	CREATININE	MICROALBUMINURIA	ECG	TREATMENT	DM	CAD
Raja	52	M	ip	10	172	80	normal	70	146	90	14	11.9	154	20	0.7	present	normal	irregular	no	no
Lakshmi	38	F	op	3	150	78	normal	55	116	74	13.4	11.2	90	11	0.6	absent	normal	regular	no	no
Kumar	66	M	op	7	168	68	normal	62	160	96	14.5	13.8	119	24	0.8	present	normal	irregular	no	no
Shankar	70	M	ip	9	180	88	normal	71	154	100	11.9	14.1	204	26	0.9	present	normal	irregular	no	no
Selva	45	M	op	3	160	76	normal	57	100	70	12.5	11.3	177	30	0.4	absent	normal	regular	no	no
Rani	54	F	op	12	170	68	normal	92	180	110	10.9	14.15	169	14	0.7	present	lvh	irregular	no	no
Prabhu	48	M	op	7	163	78	normal	68	134	68	15	10.9	109	16	0.8	absent	normal	regular	no	no
Ibrahim	60	M	op	9	167	90	normal	61	144	82	12.8	13.5	256	19	0.6	absent	lvh	regular	no	no
Seetha	50	F	op	7	162	78	normal	49	172	98	13.9	15.2	218	24	0.9	present	lvh	irregular	no	no

Ramesh	68	M	op	13	155	68	normal	73	126	78	14.4	14	160	26	0.8	absent	normal	irregular	no	no
Peter	44	M	op	3	160	74	normal	57	156	84	11.6	13.9	153	28	0.7	present	normal	irregular	no	no
Sathiya	74	M	op	16	165	72	normal	81	148	86	10.9	14.05	199	31	1	absent	normal	regular	no	no
Ramiya	68	F	op	5	158	60	normal	62	174	106	11.7	13.6	186	38	0.8	present	lvh	irregular	no	no
Shanmugam	39	M	op	1	169	70	normal	79	166	90	13.6	13.7	169	41	0.9	absent	normal	regular	no	no
Swamy	56	M	op	4	172	80	normal	58	136	80	10.2	12.8	301	18	1.1	absent	lvh	regular	no	no
Kumar	61	M	op	8	148	76	normal	75	124	74	13.9	14.2	234	19	0.9	absent	normal	regular	no	no
Ammu	74	F	op	19	151	68	normal	69	158	88	14	13.65	178	33	0.7	present	normal	irregular	no	no
Mohan	48	M	op	6	168	78	normal	88	118	70	12.3	12.6	134	27	0.8	absent	normal	irregular	no	no
Shanthi	70	F	op	8	170	66	normal	83	100	64	15	13.5	213	19	0.7	present	normal	regular	no	no
Prasanth	65	M	ip	14	178	82	normal	70	184	122	11.8	14.25	179	32	1	present	lvh	regular	no	no

Selvaraj	46	M	op	3	166	80	normal	67	146	78	13	11.9	284	36	1.1	absent	normal	irregular	no	no
Anitha	53	F	op	5	170	68	normal	90	156	90	14.6	13.6	270	23	1.2	present	normal	irregular	no	no
Aarthi	47	F	op	4	159	70	normal	59	114	68	15	12.9	180	19	0.9	absent	normal	regular	no	no
Arul	68	M	op	9	170	78	normal	53	152	88	13.8	13.9	169	28	1.2	present	normal	irregular	no	no
Gayathri	66	F	op	13	164	86	normal	67	116	70	15.2	12.6	188	31	0.8	absent	normal	regular	no	no
John	70	M	ip	17	177	84	normal	97	174	116	13	14.3	140	32	0.6	present	normal	regular	no	no
Sagayam	57	M	op	7	160	82	normal	80	186	120	13.4	14	116	18	1.3	present	lvh	irregular	no	no
Vivek	63	M	op	8	170	74	normal	59	118	64	13.9	13.1	129	25	1.1	absent	normal	regular	no	no
Karthikeyan	59	M	op	11	165	76	normal	72	146	78	14.2	14.1	149	27	0.9	present	normal	irregular	no	no
Jumuna	49	F	op	7	155	68	normal	55	170	116	12.8	13.9	170	31	0.8	present	normal	irregular	no	no
Vijay	45	M	op	3	168	66	normal	68	148	100	13.9	12.8	160	16	0.8	absent	normal	irregular	no	no

Vikaram	52	M	op	7	158	78	normal	69	156	90	14	14.2	211	19	1.3	present	normal	regular	no	no
Ram	61	M	op	8	148	88	normal	54	140	88	13.1	12.5	197	26	0.9	absent	normal	irregular	no	no
Krishnan	72	M	ip	13	173	80	normal	49	154	96	15	13.5	142	29	0.8	present	lvh	regular	no	no
Giva	45	M	op	4	150	82	normal	74	134	86	14.8	11.9	174	32	0.7	absent	normal	regular	no	no
Siva	76	F	ip	18	180	78	normal	96	190	110	13.9	15	133	36	1	present	lvh	irregular	no	no
Ramu	64	M	ip	13	175	88	normal	49	108	72	12	11.8	131	24	1.1	absent	normal	regular	no	no
Murali	55	M	op	6	163	70	normal	73	138	88	14	12.2	162	19	0.9	absent	normal	regular	no	no
Suresh	61	M	op	7	165	76	normal	60	168	100	14.8	13.5	153	21	1	present	normal	irregular	no	no
Jenifer	59	F	op	11	160	68	normal	78	156	90	13.7	13.4	132	29	0.8	present	normal	regular	no	no
Ganesh	48	M	op	4	157	74	normal	85	170	108	15	12.8	123	37	0.9	absent	normal	regular	no	no
Subramanian	63	M	ip	12	174	68	normal	64	136	74	13	14.3	110	41	1.1	present	normal	regular	no	no

Mani	70	M	op	10	157	78	normal	81	162	102	12.9	11.9	266	32	0.7	absent	normal	regular	no	no
Thomas	44	M	op	4	165	70	normal	59	114	66	14	12.8	174	26	0.9	absent	normal	regular	no	no
Sudha	58	F	op	7	163	86	normal	68	126	70	14.7	13.4	109	35	0.9	absent	normal	regular	no	no
Philip	54	M	op	6	169	92	normal	60	130	82	12.8	13.7	201	24	1.1	present	normal	irregular	no	no
Rajesh	48	M	op	3	161	78	normal	87	142	88	13.7	12.5	277	40	1	absent	normal	regular	no	no
Rajkumar	72	M	op	15	158	74	normal	76	150	98	14.1	13.6	179	34	0.8	present	normal	regular	no	no
Veera	66	M	op	8	153	68	normal	57	108	70	13.8	14.1	164	26	0.7	present	normal	irregular	no	no
Muthulakshmi	50	F	op	6	168	90	normal	70	118	60	14	12.9	160	30	0.8	absent	normal	regular	no	no