ASSOCIATION OF SERUM URIC ACID LEVELS IN ACUTE ISCHEMIC STROKE

Dissertation submitted to

THE TAMILNADU DR. M.G.R MEDICAL UNIVERSITY

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In partial fulfilment of regulations

For award of the degree of

M.D (GENERAL MEDICINE)

BRANCH – 1

KILPAUK MEDICAL COLLEGE

CHENNAI 600 010

April 2015

BONAFIDE CERTIFICATE

This is to certify that dissertation named **"ASSOCIATION OF SERUM URIC ACID LEVELS IN ACUTE ISCHEMIC STROKE"** is a bonafide work performed by Dr.J.Harikrishnan, post graduate student, Department of Internal Medicine, Kilpauk Medical College, Chennai-10, under my guidance and supervision in fulfilment of regulations of the Tamilnadu Dr. M.G.R Medical University for the award of M.D. Degree Branch I (General Medicine) during the academic period from May 2012to April 2015.

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DECLARATION

I solemnly declare that this dissertation **"ASSOCIATION OF SERUM URIC ACID LEVELS IN ACUTE ISCHEMIC STROKE"** was prepared by me at Government Royapettah Hospital, Chennai, under the guidance and supervision of **Dr. R.Sabaratnavel M.D.**, Professor, Department of Internal Medicine, Government Royapettah 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.J.Harikrishnan)**

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Ref.No.3182/ME-1/Ethics/2014 Dt:08.05.2014.
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "A Study on association of serum uric acid levels in acute ischemic stroke" – For Project Work submitted by Dr.J.Harikrishnan, MD (GM), PG Student, KMC, Chennai-10.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

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30 MAY 2014
Kilpauk, Chennai-10.

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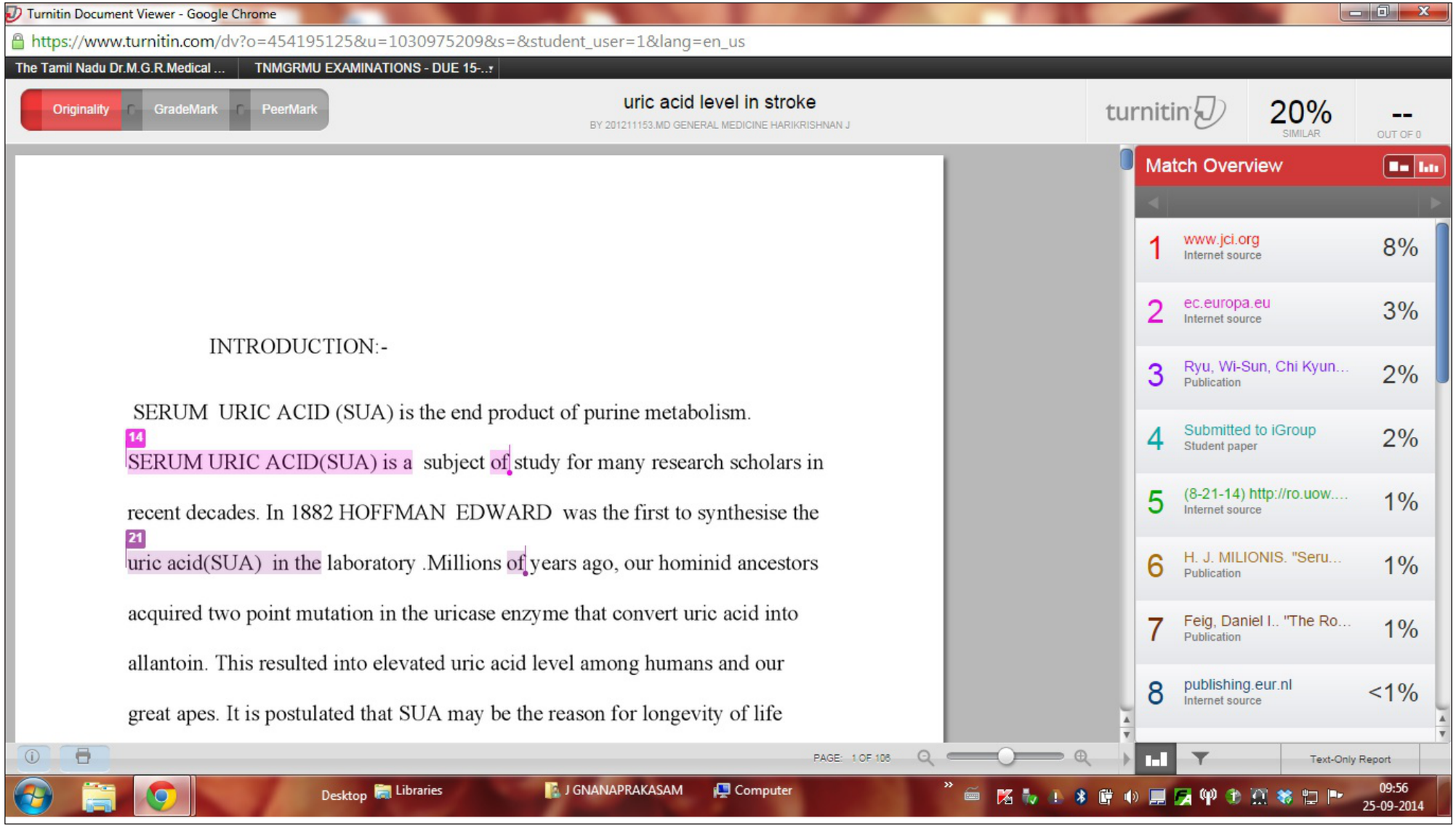
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ABSTRACT

BACKGROUND:

For decades the role of Uric acid as a independent risk factor for non-communicable disease is a subject of discussion. Serum Uric acid is a powerful antioxidant that scavenge many harmful free radicals like hydroxyl ions, peroxinitrite along with other anti-oxidants like ascorbic acid .But elevated serum uric acid can act as pro-oxidant that cause various inflammatory reactions .serum uric acid can cause endothelial dysfunction, nitric oxide reduction in cells, platelet dysfunction, vascular smooth muscle cells proliferation and activates RAAS.

AIM:

- To study the association between serum uric acid level and acute ischemic stroke.
- To study the association between serum uric acid level and other risk factors like SHT, DM,CAD, Obesity.

METHODS:

This is an analytical cross sectional study done at Govt Royapettah Hospital. Serum uric acid levels were measured within 24hrs of onset of scute ischemic stroke. 50 patients were studied. Serum uric acid level was taken as 6.5mg/dl.This value was compared with various other variables.

RESULTS:

Of the study population 66% were male and 34% were female. 38% of the population were <60yrs ad 62% were>60 yrs of age. 76% were hemiparetic and 24% were hemiplegic. 76% had serum uric acid <6.5mg/dl and 24% had serum uric acid levels >6.5mg/dl. The study revealed the strong association between the serum uric acid and DM,SHT,CAD, Dyslipidemia with a p value <0.05. The study also revealed that the association of uric acid with age and smoking was insignificant with p value >0.05. All patients admitted with hemiplegia have serum uric level >7mg/dl which is highly significant.

CONCLUSION:

The study shows that uric acid levels may be considered as an independent predictor for ischemic stroke. SUA has a strong association with DM, SHT and CAD.

INTRODUCTION

SERUM URIC ACID (SUA) is the end product of purine metabolism. SERUM URIC ACID (SUA) is a subject of study for many research scholars in recent decades.

In 1882 HOFFMAN EDWARD was the first to synthesise the uric acid(SUA) in the laboratory. Millions of years ago, our hominid ancestors acquired two point mutation in the uricase enzyme that convert uric acid into allantoin. This resulted in elevated uric acid levels among humans and our great apes. It is postulated that SUA may be the reason for longevity of life when compared to other mammals.

SUA is a powerful anti-oxidant along with VITAMIN E and VITAMIN C. SUA normally scavenge HYDROXYL, PEROXY NITRITE, and other pro-inflammatory free radicals. But many recent research journals revealed that protective SUA under certain physio-biochemical condition may turn to be a toxic substance inflicting injuries to the cells.

Association of elevated uric acid in reducing the intra cellular nitric oxide causing platelet and endothelial dysfunction , and vascular smooth muscle proliferation may be responsible for development various risk factors in non- communicable diseases. Elevated NADPH OXIDASE , recruiting more MCP-1(monocyte chemoattractant protein) blocking L - ARGININE

(precursor of NO) stimulating PDGF (platelet derived growth factor) are the proven effects of elevated SUA, that clearly state that elevated SUA is toxic .

Nearly two centuries after the discovery of SUA many papers have been published about its association with metabolic syndrome, cerebro vascular disease, coronary artery disease and gout. ARIC (ATHEROSCLEROSIS RISK IN COMMUNITIES), FRAMINGHAM'S STUDY ,BRHS STUDY, REYKJAVIK STUDY, PROCAM STUDY, NHEFS STUDY, NHANEIS STUDY, revealed the association of SUA with the risk factor of NON-COMMUNICABLE DISEASE.

Among the neurological diseases, the cerebrovascular diseases(CVD) rank the first in frequency and importance. At least 50% of the neurological disorders in a general hospital are CVD. Stroke, after heart disease and cancer is the most common cause of death. In the developing countries like INDIA we face dual burden of COMMUNICABLE DISEASE AND NON-COMMUNICABLE DISEASE.

The prevalence rate of Cerebro vascular disease (CVD) in INDIA is 84-262 per 100000 persons in rural population and 334-424 per lakh persons in urban population. In TAMIL NADU the prevalence is around 56.9 per 100000 persons. Recent studies reveals that increased occurrence of risk factor for

stroke among adult population. All the physicians have a role to play in the prevention of stroke by encouraging the reduction in risk factors .

Stroke also entails a high socio economic burden due to increased morbidity and mortality. Ischemic strokes account for > 80% of total stroke events. Early identification of individuals at risk could be of help in primary prevention strategies.

Since SUA is associated with all the risk factors of cerebrovascular disease, this study could be used to support the evidence that serum uric acid may be used as a early marker for development of cerebrovascular disease.

AIM OF THE STUDY

The study is conducted to analyse the association of SERUM URIC ACID levels and acute ischemic stroke and to assess its risk factor potential.

To study the association between SERUM URIC ACID levels and other risk factors like CAD, SYSTEMIC HYPERTENSION, DIABETES MELLITUS, DYSLIPIDIMIA and others.

REVIEW OF LITERATURE

URIC ACID

Background:

The study substance Serum Uric Acid (SUA) is the final product of Purine metabolism. In spite the study substance Serum Uric Acid was discovered 200 years before, the Patho-physiology and the biological actions have to be researched more. For years together the study substance serum Uric Acid was believed to be a protective molecule for humans. Recent studies have shown that the study substance serum Uric Acid may be a both edged sword under certain biochemical conditions. From the following study, various biochemical properties of the study substance serum Uric Acid will be discussed.

CHEMISTRY OF URICACID

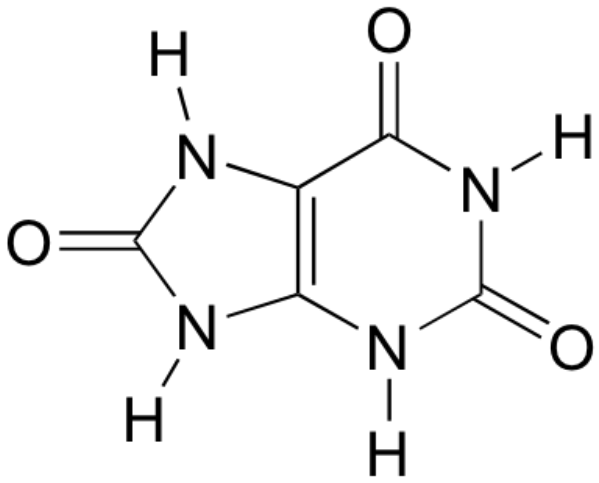
The study substance serum Uric Acid is a heterocyclic compound with molecular formula C5H4N4O3.

Its Molar mass: 168.11g/mol.

Its Melting point: 300 degree C.

Its Acidity (pKa): 5.6 and Basicity: 8.4.

URICACID STRUCTURE



uric acid

SOURCES OF URIC ACID

Purine sources:

A] Dietary sources like pork, poultry, fish, beef, cauli-flower, spinach, mushroom, green peas, oat meal, sweet bread, sardines are rich in Uric acid.

B] Degradation of endogenous nucleotides.

C] De-novo synthesis (energy recurring process).

Endogenous Nucleotides:

DNA is the polymer of nucleotides; the fundamental unit of nucleic acid is nucleotide. DNA is found only in cell nucleus not in cytoplasm unlike the

RNA. Purines are biologically synthesised as nucleotides. Adenine and Guanine are major Purines. Uric acid is the final oxidation product. Hypo-Xanthine and Xanthine are intermediate products. The rate limiting step in the synthesis of uric acid is catalysed by the enzyme Xanthine-Oxidase. Xanthine Oxidase contains molybdenum bound to sulphur and oxygen. It exists in two forms Xanthine Oxidase and Xanthine Dehydrogenase.

Nucleotide

⇓

1. Nucleoside 2. Phosphate

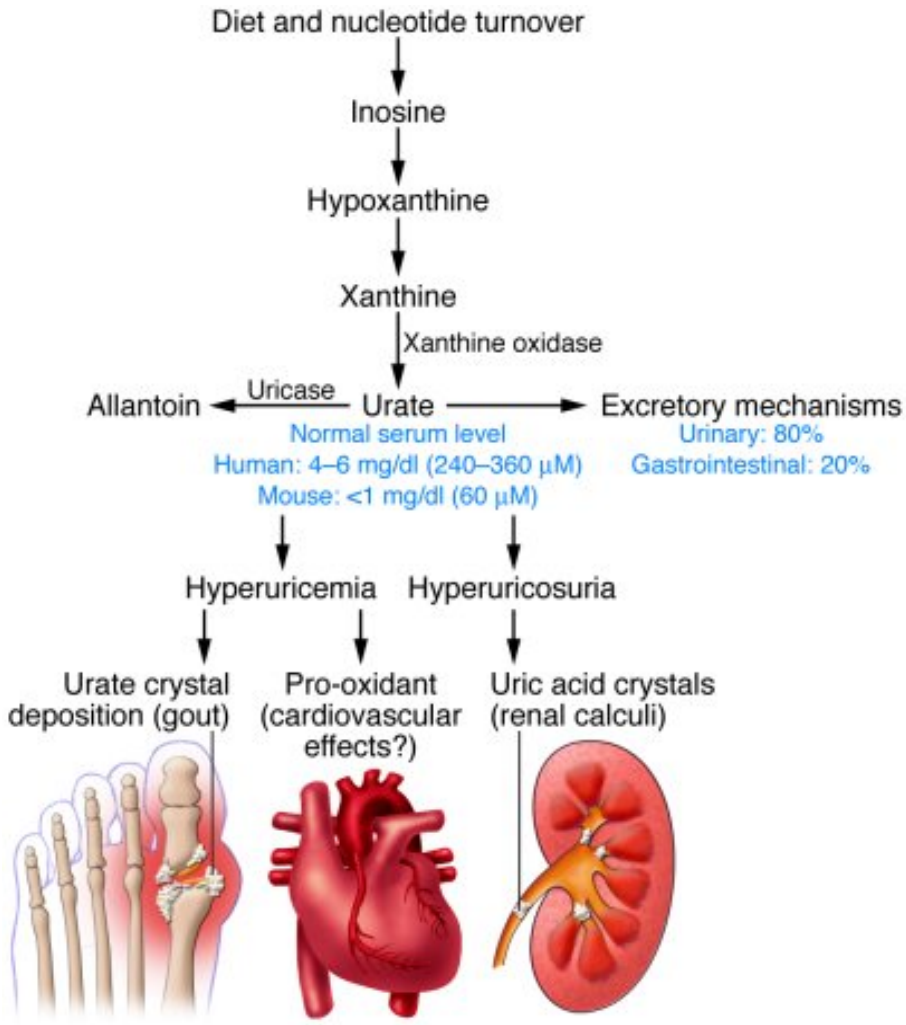
⇓

a).Base b).Sugar

⇓

Purine , Pyrimidines

DENOVO SYNTHESIS OF URIC ACID



Pathways of urate homeostasis is to produce uric acid, to convert it into allantoin by the liver enzyme uricase, and to excrete it. The balance between these pathways regulates blood urate concentrations, which are higher in humans and apes due to inactivation of the uricase genes. Hyperuricemia can lead to gout and possibly to cardiovascular effects, whereas hyperuricosuria may leads to uric acid crystal–induced pathologies.

SALVAGE PATHWAY:

This pathway converts the purines to their parent nucleotide and it is energy conserving pathway. Enzymes involved are Hypoxanthine – Guanine Phosphoribosyl Transferase (HGPRT) for Guanine and Hypoxanthine. Adenine Phosphoribosyl Transferase (APRT) for Adenine. Purine metabolism end product is Uric acid. Pyrimidine metabolism end product is Urea.

Other than some higher primates and humans, the final oxidation product of Purine metabolism, Uric acid is converted to Allantoin by Uricase enzyme. Million years ago, our hominid ancestors acquired a double step mutation in the gene for Uricase. Hence, they have higher level of Uric acid than most of the other mammals.

Uricase is a hepatic enzyme that produces Allantoin. Rat, Kangaroo, Birds and Reptiles though the uric acid is produced, it is excreted as dry mass, thereby conserving water for their body.

In humans, uric acid is excreted in kidney and in gut. It is degraded to carbon-dioxide and ammonia. In humans, SUA is filtered by glomerulus, reabsorbed at proximal tubules, secreted at distal tubule and only 10% of the filtered Uric acid is excreted. The urate reabsorption pathway involves the apical exchanger proteins URAT1, OAT4, and OAT10; intracellular urate is released through basolateral Glut 9.

Urate uptake by URAT1 and OAT10 is accelerated by intracellular monocarboxylates such as lactate, pyrazinoate, and nicotinate and by dicarboxylates for OAT4. Several apical monocarboxylate transporters are required to favour urate reabsorption, such as MCT9 and SMCT1 and -2 . The excretion pathway involves the basolateral urate/di-carboxylate exchangers OAT1 and OAT3 and the apical ATP-binding cassette proteins MRP4 and ABCG2, as well as the sodium/phosphate co-transporters NPT1 and NPT4.

Functional organization of the apical transporters is regulated by interactions with PDZ domains present in URAT1, NPT1, OAT4, and the sodium/monocarboxylate co-transporter SMCT1 and with PDZK1 and NHERF1; and influenced by changes in actin polymerization regulated by the protein CARMIL, as determined by biochemical and genetic studies .

Urate transport in the mouse kidney involves both the proximal and distal convoluted tubules (middle and lower left panels). The same urate-transporting proteins present in humans are found in the mouse proximal tubules, except for Glut9, which is present at extremely low levels. In mice, in contrast to humans, Glut9 is present at very high levels in both the apical and basolateral poles of distal convoluted tubule cells. However, it is not known which isoform of Glut9 is present in the apical and basolateral membranes.

REFERENCE VALUES:

Men: 200-430 micro mol/litre or 3.4 – 7.2 mg /dL

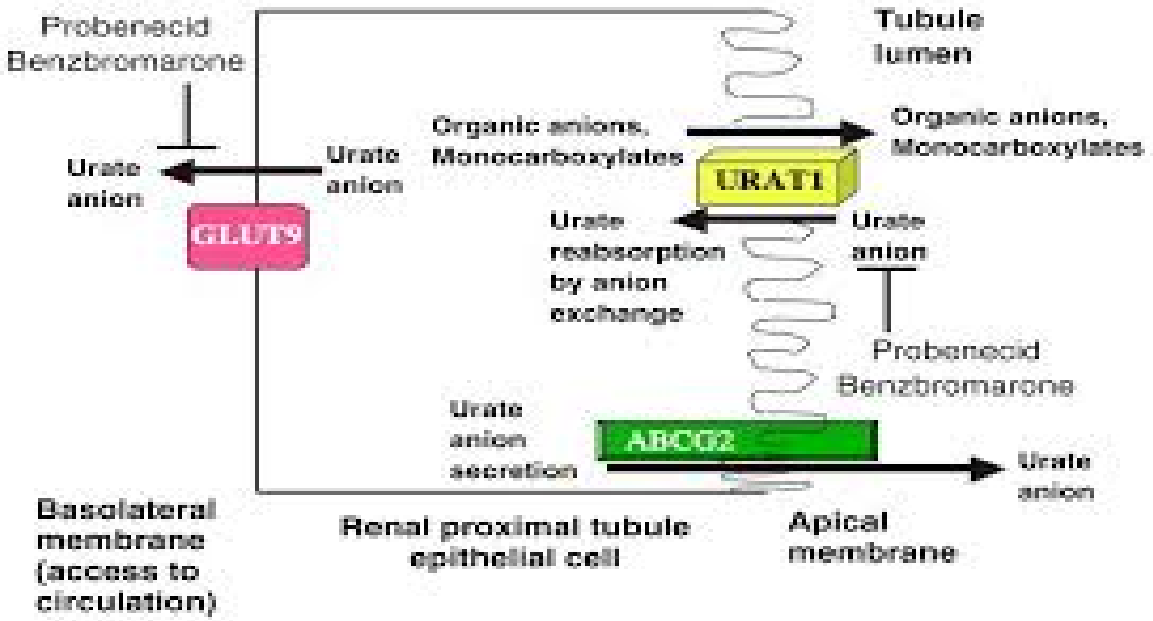
Women: 140-360 micro mol/litre or 2.4 – 6.1 mg/dL

GENETICS:

The genes responsible for Uric acid excretion include SLC2A9, SLC16AG, SLC23A11 and PDZK1.

SCL2A9 is responsible for GLUT-9 isoform that transport Uricacid.

Fig: URICACID IN PCT INVOLVING GLUT- 9



Defect in the metabolism and excretion of the study molecule Uricacid can lead to hyper uricemia or hypo uricemia which is mainly due to the hyper uricosuria and hypo uricosuria.

CAUSES OF INCREASED URIC ACID LEVELS:

- Physiological and environmental factors.
- Primary Hyperuricemia.
- Secondary Hyperuricemia.

Primary hyperuricemia:

- Idiopathic.
- Von Grieke Disease due to Glucose -6- phosphatase deficiency.
- Lesch-Nyhan syndrome due to HGPRT-ase deficiency.

Secondary Hyperuricemia:

- Diuretics.
- Lactic Acidosis.
- Keto-acidosis.
- Low dose salycilate.
- Renal failure.

- Myeloproliferative Disorders like PCV.
- Lymphoma.
- Leukemia.
- Multiple myeloma.
- Cytotoxic Therapy for malignancy.
- Psoriasis.
- Diet with high fructose corn syrup that inhibit the enzyme uricase.
- Rapid reduction in Body Mass Index.
- Prolonged fasting.

CAUSES OF DECREASED URIC ACID LEVELS:

- Zinc Deficiency.
- Phosphate binders like sevelamr.
- Iron and Molybdenum deficiency.
- Excess of copper.
- Congenital cause like Molybdenum cofactor deficiency and Multiple Sclerosis

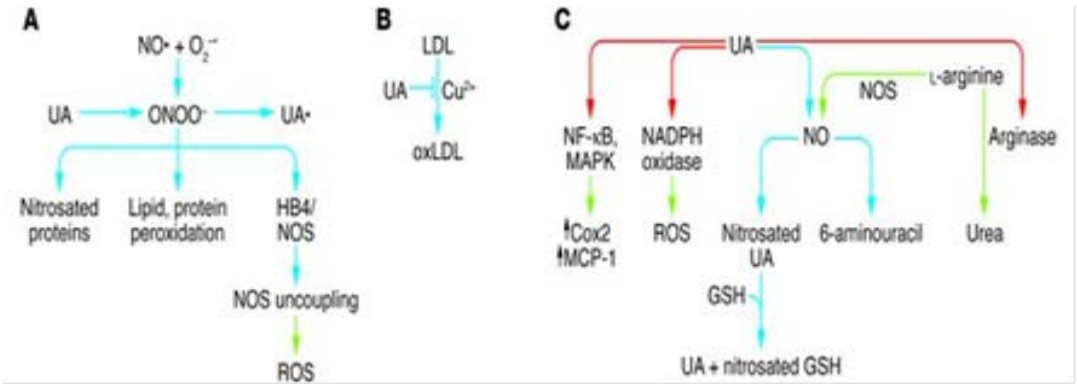
URIC ACID: THE OXIDANT – ANTIOXIDANT RECENT REVIEWS

The study molecule uric acid is the major antioxidant in blood but only under certain physiological conditions and in normal reference values. Presence of Ascorbic acid is essential for the antioxidant activity. Like Ascorbic acid it is an electron donor and scavenges the free radicals.

In 1800, Sir Alfred Garrod found first evidence of elevated uric acid in patients with gout. Hoffman Edward was first to synthesis uric acid in laboratory. Fredric Akbar Mohammed in Lancet paper explained the association of uric acid in Systemic Hypertension.

Later, many researchers published various articles on uric acid and its association with Coronary Artery disease, Chronic Kidney Disease, Cerebro-Vascular disease, Metabolic syndrome, Obesity and Systemic Hypertension.

Fig: OXIDANT – ANTIOXIDANT PARADOX



URIC ACID: ANTIOXIDANT

Kellog and Friedrich described the mechanism by which the study molecule scavenges the oxygen radicals and protects the RBC membrane from lipid oxidation.

Uric acid protect the Hemoglobin from auto- oxidation and peroxide effects of macrophages.In Nervous system disorders , particularly in Multiple scelerosis, Parkinsonism and acute stroke the role of the study molecule is well recognized.

Eventhough, chronic elevation of uricacid is associated with increased stroke risk in acute condition the study molecule has some productive value which is to be researched further.

From the mouse model of experimental allergic encephalomyelitis, the study molecule increases the Blood Brain Barrier and thereby decreases the infiltration by leucocytes. They also block the peroxinitrite (ONOO) mediated nitrosylation of neural proteins. Excess Bicarbonate and reduced Ascorbic acid significantly inhibits the Antioxidant activity.

Antioxidant activities include:

(1) Peroxynitrites (ONOO–) are produced from the reaction of nitric oxide (NO•) with superoxide (O2–•). Peroxynitrites can induce protein nitrosation and

lipid and protein peroxidation and block tetrahydrobiopterin (HB4), a cofactor necessary for NOS activity. In the absence of HB4, NOS produces ROS. Uric acid (UA) can directly inactivate peroxynitrite by a reaction that generates uric acid radicals (UA•); these can be rapidly eliminated by plasma ascorbic acid.

(2) Uric acid can also prevent Cu2+-induced oxidation of LDL, a reaction that may protect against atherosclerosis development.

(3) By enhancing arginase activity, uric acid diverts l-arginine from NO production to urea production. Uric acid can also directly react with NO to generate nitrosated uric acid, and the nitroso group can then be transferred to glutathione (GSH) for transport to another recipient molecule.

Fig: URIC ACID – PEROXINITRITE ANTIOXIDANT MECHANISM

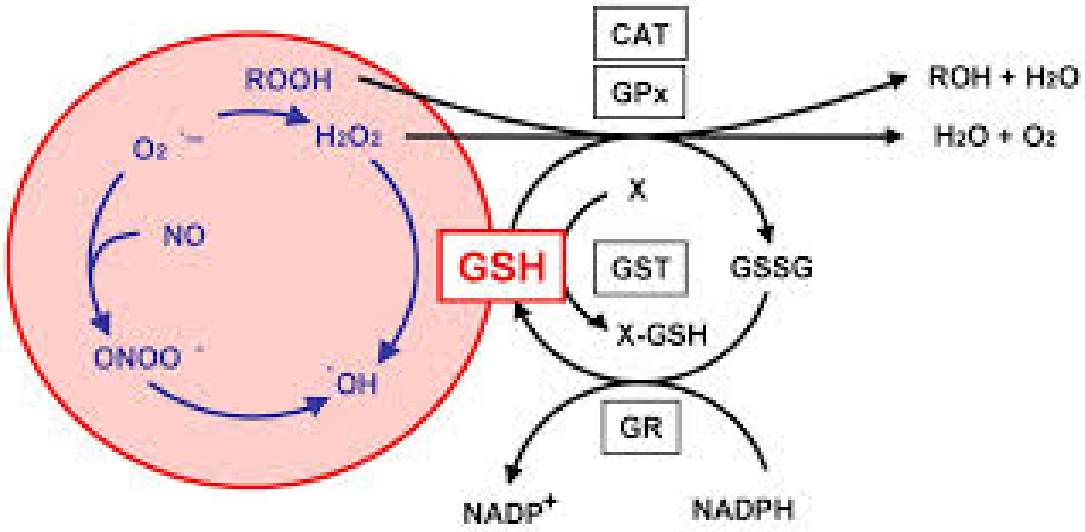
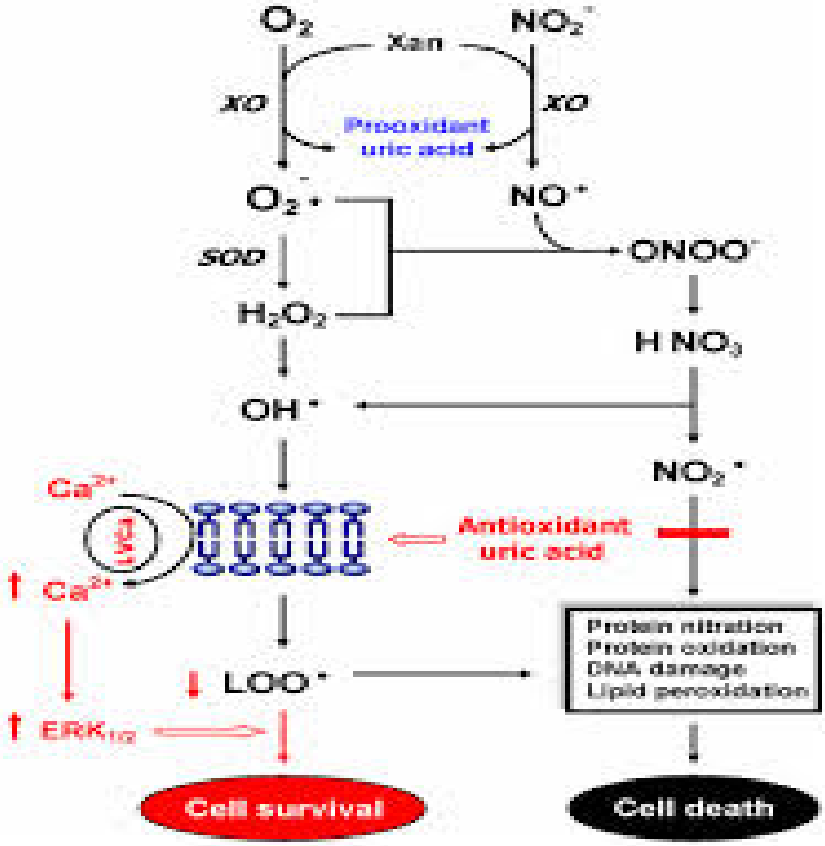


Fig: PRO-OXIDANT - ANTIOXIDANT MECHANISM



URIC ACID : A PRO-OXIDANT

Persistent higher value of Uric acid with elevated fructose levels in absence of anti-oxidants like Ascorbic acid cause activation of fructo-kinase with ATP consumption. This further increases the study molecule and reduction in intracellular ATP. This results in oxidative stress and release of inflammatory cytokines.

The following are the mechanisms of pro oxidant study molecule.

- Endothelial dysfunction.
- Reduction of intra cellular NO.
- RAAS activation.
- Excess of sympathetic nervous system activation.
- Vascular smooth muscle cells activity alteration.
- Increased cell membrane lipids oxidation.
- Promote atheroscelerosis by its LDL oxidation action.

Free radicals associated with Uric acid represents different degrees of degradation, the radical site found in the five membered ring of purine structure.

Aminocabonyl, a carbon centered radicals associated with purine structure breakdown, formed from ONOO attack. The study substance at concentration more than 500 micro-grams amplifies the oxidation of LDL by peroxinitrite and LDL oxidation. They also propagate the oxidative damage. Of all cellular components lipids are predominantly affected. Presence of copper promotes the oxidation reactions of the study molecule. Lipids molecules play an important role in converting uric acid – a pro-oxidant.

Inclusion of Uric acid in to the vessel wall (media of blood vessels) result in additional generation of reactive oxygen species.

The Uric acid actions are attenuated by N-acetyl cysteine, DPI, NADPH oxidase inhibitors and apo- cyanine.The study molecules also interfere with the electron transport chain and cause ATP depletion, causing an oxidative stress injury.

Nitric Oxide(NO), described initially as an endothelial cell–derived relaxing factor, is an important regulatory molecule in the cardiovascular system, and reduced NO levels is associated with hypertension and insulin resistance. Urate can react directly with NO under aerobic conditions to generate an unstable nitrosated uric acid product that can transfer NO to other molecules such as glutathione.

Under anaerobic conditions, urate is converted in the presence of NO into stable 6-aminouracil. The possibility that increased urate plasma levels can reduce NO bioavailability has been tested in rats treated with the uricase inhibitor oxonic acid. The consequent increase in plasma uric acid was indeed associated with a decrease in plasma nitrites/nitrates (NOx).

Similarly, direct exposure of endothelial cells to uric acid slightly reduces basal or VEGF-stimulated NO production. Thus, uric acid can dose-dependently reduce NO bioavailability.

Although a direct chemical reaction of urate with NO could explain the decrease in plasma NOx, there is evidence that in vivo urate can decrease NO production by interfering with its biosynthesis.

The SUA increases the NADPH oxidase activity, especially its isoform NOX4, NOX3 and classical NOX2. NOX activation causes translocation of regulatory sub units' p40ph0x from cytoplasm to cell membrane promoting the pro inflammatory activity.

Another pro-oxidant action of urate has been described during adipogenic differentiation of 3T3-L1 cell. When these cells are induced to differentiate into adipocytes, addition of uric acid at physiological concentrations further increases ROS production by a mechanism that involves activation of NADPH oxidase. This effect in adipocytes may participate in the induction of inflammation and insulin resistance of adipose tissue observed in obesity. In vascular smooth muscle cells, uric acid has been reported to stimulate MCP-1 production following activation of NF-κB, MAPKs, and cyclooxygenase 2.

Fig: URIC ACID AND ENDOTHELIAL DYSFUNCTION

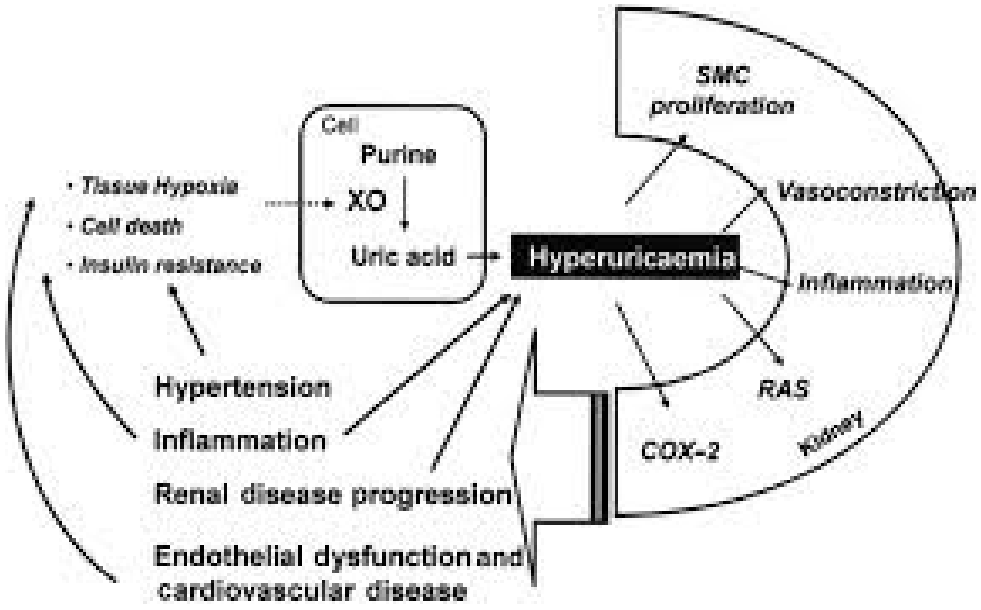
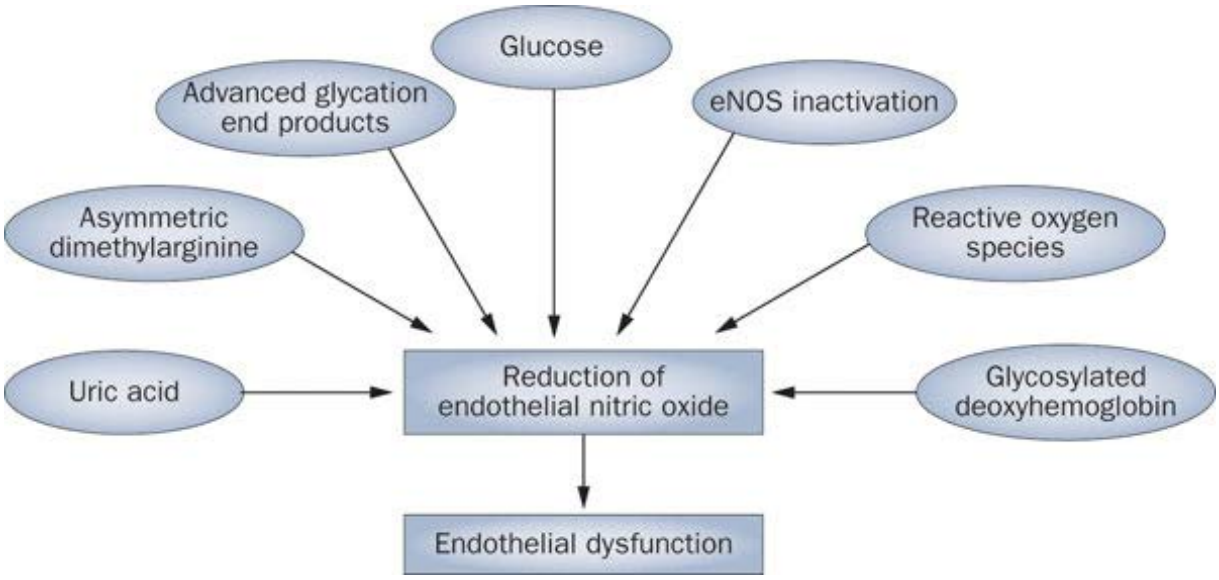


Fig: MECHNANISM OF ENDOTHELIAL DYSFUNCTION



In the presence of oxygen, uric acid reacts with NO to produce the stable species 6-aminouracil. Uric acid uptake in adipocytes activates NADPH oxidase and increase production of ROS, which can initiate an inflammatory reaction. In vascular smooth muscle cells, uric acid can activate the NF-κB and MAPK pathway and increase cyclooxygenase and MCP-1 production. The available information indicates that uric acid has complex chemical and biological effects and that its pro-oxidant or NO-reducing properties may explain the association among hyperuricemia, hypertension, the metabolic syndrome, and cardiovascular disease.

In addition, when hyperuricemia leads to the formation of microcrystals, it leads to joint and renal inflammation. Chronic inflammation (as in tophaceous gout) leads to bone and cartilage destruction, and chronic hyperuricemia and hyperuricosuria in gouty patients are also frequently associated with tubulointerstitial fibrosis and glomerulosclerosis, signs of local renal inflammation .

Part of this is explained by the activation of the NALP3 inflammasome to process and secrete IL-1β, but other pathways of inflammation have also been demonstrated.

Thus, the Uric acid major anti oxidant in our body under certain conditions can act as pro oxidant causing CAD , CVA , Metabolic syndrome , SHT and Stroke.

Fig: ROLE OF URIC ACID IN THE PATHOGENESIS OF COMMON DISORDERS

Disorder	Mechanism
Gout • Primary • Secondary	
- Usage of specific drugs or intoxication (19)	Alcohol reduced renal urate excretion in lactic acidemia; Several antihypertensives interfere with renal tubular ion transport; Immunosuppressants (i.e. cyclosporine), reduce renal clearance of serum urate.
- Renal failure (20)	Impaired kidney function.
- Familial juvenile hyperuricemic nephropathy (90)	Mutation of gene for uromodulin.
- Autosomal-dominant medullar cystic kidney disease (91)	Mutations of genes for polycystins 1 (PC1) and 2 (PC2).
Cardiovascular disorders (8,64,69) • Coronary heart disease • Congestive heart failure • Stroke • Peripheral artery disease	Endothelial dysfunction, oxidative stress, inhibition of NO-synthesis.
Hypertension (8,64,69,72,89)	Endothelial disfunction (60); Activation of renin-angiotensin system (55); Impaired glomerular filtration rate (63); Inhibition of NO-synthesis.
Chronic kidney disease (8)	Increased monocyte chemoattractant protein (MCP-1) in cultured vascular smooth muscle cells and human proximal tubular epithelial cells.
Metabolic syndrome and its components (79) • Insulin resistance • Obesity • Hyperlipidemia • Hypertension	Increased intracellular adenosine (uric acid precursor a derivative of higher AMP concentrations due to increased synthesis of fatty acid-acyl-CoA in peripheral tissues.
Therapy of cancer	Purine derivatives

CEREBROVASCULAR ACCIDENT AND URIC ACID:-

The study molecule uric acid has been the substance of interest for researchers for decades regarding its neuroprotective or toxic effects. Recent journals have strongly implicated the study molecule as a cause for cerebrovascular disease.

Uric acid induce various physiological changes in the vascular system and may contribute to pathogenesis of ischemic stroke. The following are the mechanisms of uric acid in the vascular system that leads to occurrence of stroke:

- Dysfunction of the Endothelial cells.
- Activation and proliferation of smooth muscle cells in the blood vessels
- Dysfunction of platelets
- Reduction of nitric oxide levels
- Oxidation of cell membrane lipids
- Promote atherosclerosis

ARIC (ATHEROSCLEROSIS RISK IN COMMUNITIES STUDY) came out with the report that elevated uric acid was directly and significantly associated with ischemic stroke.

B-mode ultrasound of the carotid measuring the intima medial thickness was directly proportional to the level of serum uric acid. Ischemia involving the central nervous system are associated with elevated levels of xanthine oxidase. Elevated uric acid level is directly proportional to enzyme xanthine oxidase.

Xanthine oxidase is a pro-inflammatory substance that promote the formation of various free radicals , elevates the protease level and increase the intracellular calcium level and cause cellular damage. The level of damage may be assesed by the elevated xanthine oxidase level which is the marker of elevated uric acid.

Chi Kung Kum, Beon Joom Kim came out with a study that elevated levels of study molecule may cause Cerebral micro bleeds (CMB). Subclinical vascular brain lesions are easily visualized by brain magnetic resonance image (MRI). The lesion findings are generally classified into ischemia-prone and hemorrhage-prone microangiopathy . The former has been referred as white matter lesions (WMLs) or leukoaraiosis seen on T2-weighted or fluid-attenuated inversion recovery MRI .The latter was recently identified, and has been frequently called cerebral microbleeds (CMBs). Because the nature of these lesions is small bleeding from the advanced lipohyalinized arterioles due to chronic hypertension, the CMBs have been understood to be a harbinger of cerebral ischemia.

A recent report has indicated that increased levels of uric acid are positively associated with large WMLs . Given a proven association between uric acid and vascular disease, it was hypothesized that levels of uric acid are related with the presence of CMBs.Elevated CMB's above the baseline immediately after stroke clearly shows that uric acid may be related to stroke. Further studies are neede to find an association between levels of uric acid and presence of CMBs in a large-sized consecutive series of ischemic stroke patients.

Xanthine Oxidase Inhibitor ALLOPURINOL has been used in the treatment of hyperuricemia may benefit the patient with stroke. FEBUXOSTAT also inhibits xanthine oxidase but with reduced renal complications. Practical application of the conclusion deserves strong thought and research URIC ACID, the strong anti-oxidant may have a role in acute ischmic stroke along with other anti-oxidants like Vitamin-C and Vitamin-E . SUA (serum uric acid) supress the FENTON's reaction, detoxify OH- and peroxynitrite free radicules. But chronic elevation of serum uric acid has been found to play a role in disease pathogenesis. Precise role of uric acid in cerebro vascular disease is still matter of ongoing research.

CORONARY ARTERY DISEASE AND URIC ACID:-

Since 1900, the role of uric acid in syndromeX (Metabolic syndrome) has been widely studied. Metabolic syndrome related to cardiovascular disease have the following criteria based on nutritional cholestrol educational program ATPIII.

- Abdominal obesity
- Dyslipidemia
- Raised blood pressure
- Insulin resistance+/- glucose intolerance
- Pro-inflammatory state
- Pro-thrombotic state

FRAMINGHAM"S STUDY, the largest ongoing clinical trial studied the role of uric acid in coronary artery disease has been studied. The outcome of the study clearly stated that the SUA have been associated with cardiovascular disease and metabolic syndrome. But it was not mentioned as an independent risk factor.

SUA, the study molecule uric acid cause stimulation of renin-angiotensin-aldosterone system and may contribute to the development of cad apart from development of renal vascular constriction.

Increased hs-CRP, fibrinogen, plasminogen activation inhibitor induces pro-inflammatory changes in the adipocytes and promote the occurrence of acute ischemic events.

HYPERTENSION AND URIC ACID:-

A decade ago mohamed fredrick investigated and found in gout patient that elevated blood pressure in the study patient may be due to elevated uric acid. RENAL study have clearly came out that uric acid is an independent risk factor for hypertension. Elevated SUA has been found to cause RAS activation and hence can cause SHT. They promote the renal arteriosclerosis. In kidney, urate deposition occur due to prolonged hyperuricemia. Intracellular nitric oxide is reduced so vasodilatation does not occur on stress.

Phase 1: Reversible Vasoconstriction

Uric Acid + Increased renin= uric acid dependent sodium resistant vessel wall. This phase responds to xanthine oxidase inhibitors. Intervention can alter the disease

Phase 2: Arteriolar Wall Thickening

Decreased NO+Uric Acid + Vascular smoothmuscle proliferation= uric acid independent sodium independent vessel wall.

The second phase, which develops over time, is uric acid mediated arteriolosclerosis. Uric acid uptake into vascular smooth muscle cells causes the activation and elaboration of production of growth factor (PDGF) and monocyte chemoattractant protein-1 (MCP- 1). This results in the autocrine stimulation of vascular smooth muscle cell proliferation, vascular wall thickening, loss of vascular compliance, and a shift in pressure natriuresis.

DIABETES MELLITUS AND URIC ACID:-

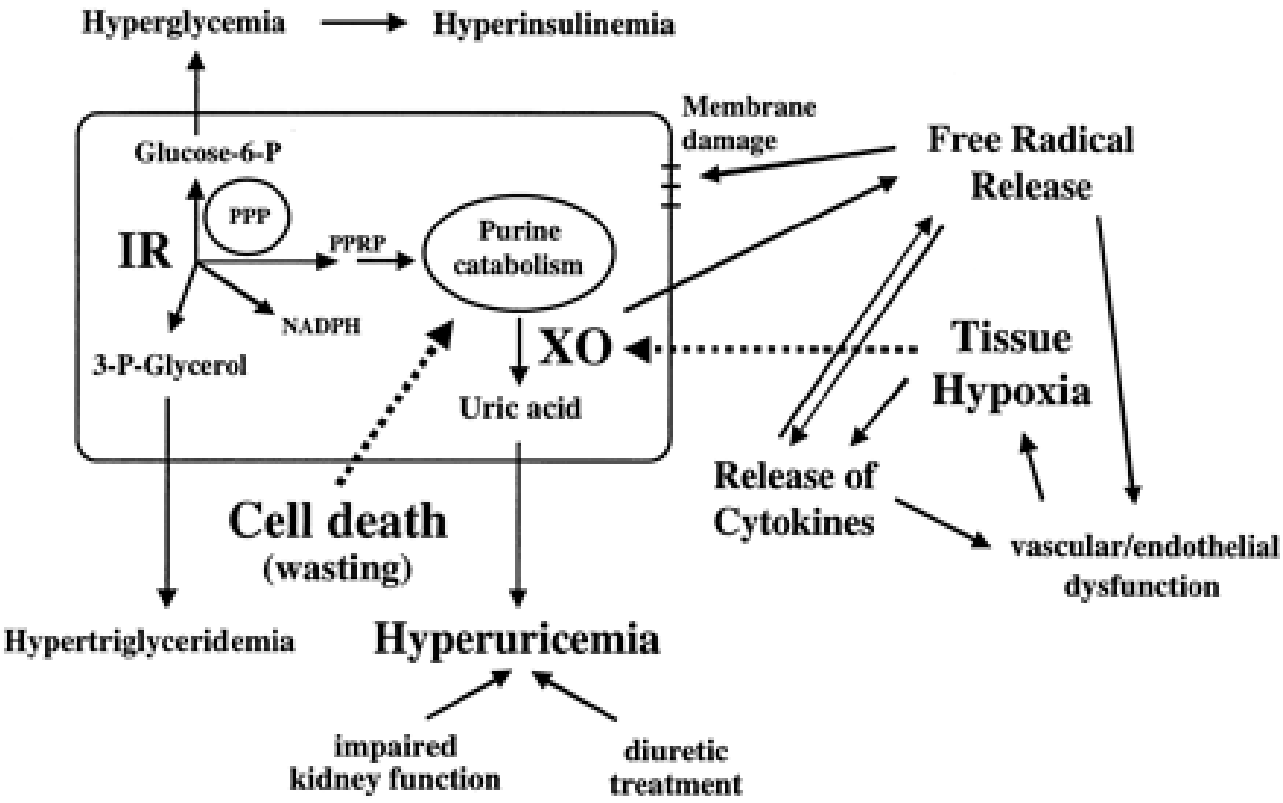
Uric acid have various effects in the body in association with diabetes like:

- SUA cause mitochondrial oxidative stress leads to fatty liver- This results in insulin resistance(IR) - *HEPATIC EFFECT.*
- SUA in adipocytes promotes NADPH oxidase that cause lipid oxidation and release super oxide radicals, MCP1 and also reduces adiponectin.This results in increased IR and leptin overexpression in visceral fat-*ADIPOSE EFFECT.*
- SUA cause reduced nitric oxide by blocking L-arginine results in IR and endothelial cell dysfunction- *VASCULAR EFFECT.*

- SUA promote macrophage induced hyalinosis cause islet cell destruction by pro-inflammatory substances and results in type2 DM- *ISLET CELL EFFECTS.*

- SUA block the ability of insulin to deliver glucose to skeletal muscle - *MUSCLE EFFECT.*

Fig: URICACID AND INSULIN RESISTANCE



CEREBRO VASCULAR DISEASES:-

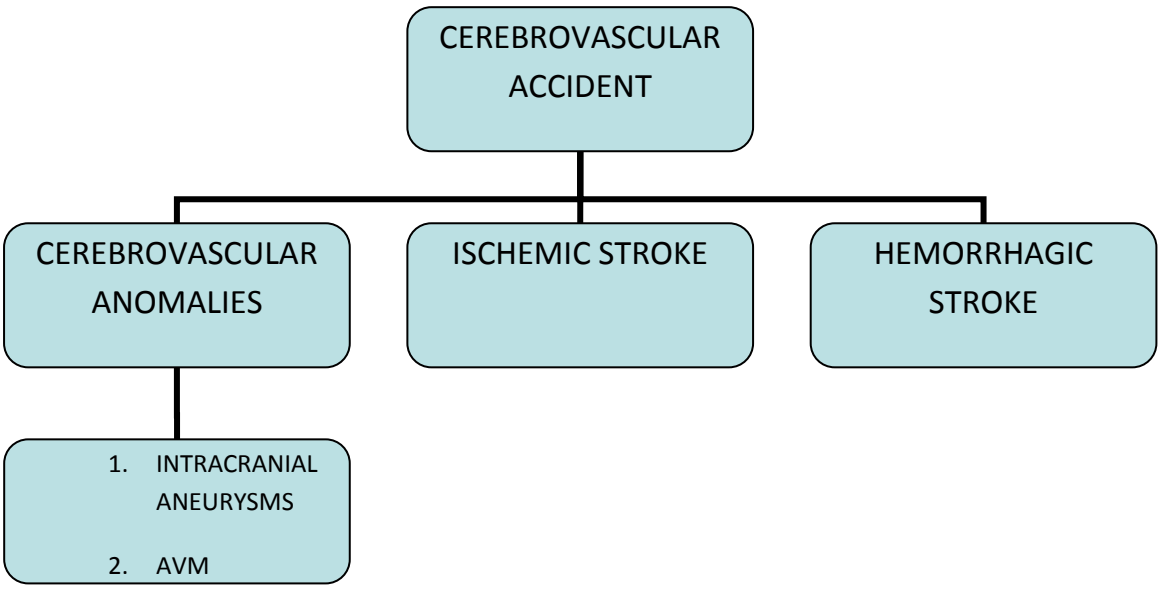
It is one of the most common disorders that devastate humans with increasing age. It is a global problem involving both the developing and the developed worlds. Increase in the incidence of stroke increases with age. The increased incidence is associated with a direct increase in the morbidity and mortality of the patients. The risk factiors for stroke are varied and their prevalence is increasing in the modern world. With the increase in the risk factors, the incidence of stroke also increases.

CHARACTERISTICS OF CVD:

- Onset is abrupt
- Characteristic neurological deficit
- Causes – Vascular
- Diagnosis is by clinical examination and relevant imaging modalities

Stroke is abrupt as if struck by the hand of God.

Fig: CLASSIFICATION OF CEREBROVASCULAR ACCIDENT



Definition and types:

Transient ischemic attack:

The neurological synptoms and signs resolves in 24 hrs regardless of imaging evidence.

Stroke :

The neurological syptoms and signs persist for more than 24hrs

Syncope:

Transient loss of consciousness due to generalised reduction of cerebral blood flow. This can be due to reduced cardiac output leading to systemic hypotension.

5 Seconds syncope is Dizziness.

10 Seconds Syncope – Unconsciousness.

15 Seconds – Convulsions.

Maximum duration of syncope is 30 seconds.

***Evolving Stroke* :**

Gradual stepwise occurence of stroke.

Completed stroke :

Stroke that does not progress beyond 96 hrs.

Young stroke:

Stroke below the age of 45yrs.

Lacunar stroke:

This is due to a small infarct less tha 15mm size secondary to the disease of the small perforating branches.

- Pure sensory
- Pure motor
- Ataxic hemiparesis

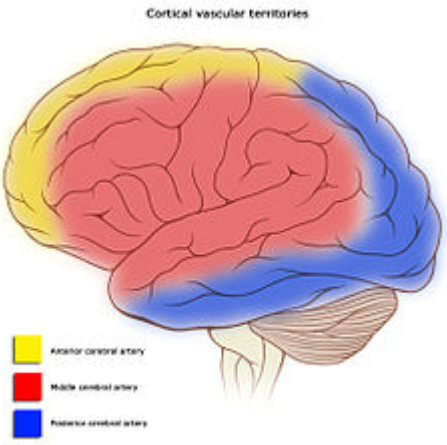
- Dysarthria clumpsy hand syndrome
- Sensory motor stroke

The major risk factor is age and hypertension which produce microatheroma, hypo-hyalinosis and dissection of tiny penetrating vessels.

Hypoxic ischemic encephalopathy:

Its a global brain injury with cognitive changes.

Fig: BLOOD SUPPLY OF THE BRAIN



PATHOGENESIS:

The main pathogenesis involves reduced blood flow to specific areas of the brain resuluting in ischemia and injury to that particular area. Decrease in cerebral blood flow to zero cause death of brain tissue within 4 – 10 minutes. Blood flow less than 16 – 18ml/100gm per minute of brain tissue cause

infarction within one hr. When the flow reduces to less than 20ml/100gm of brain tissue per minute may cause ischemia rather than infarction.

The dysfunctional brain tissue surrounding the core area of infarction is referred to as ischemic penumbra and this is the salvagable part of the brain tissue during an acute cerebrovascular accident. The penumbra can be imaged using the *perfusion-diffusion* imaging method.

Focal cerebral infarcton occurs in two distinct pathways:

- NECROTIC PATHWAY
- APOPTOTIC PATHWAY

Ischemia results in neuron death by causing a reduction in the levels of both oxygen and glucose. As a result mitochondrial dysfunction happens and the amount of adenosine triphosphate produced is reduced.

This reduction in the amount of ATP closes or reduces the activity of the membrane ion pumps. This causes depolarization of the neurons and as a result the intracellular calcium rises.

Also, with depolarization of the neuron, the excitatory neurotransmitter, glutamate is released in excess and causes activation of post synaptic glutamate receptors. This activation inturn increases the influx of calcium there by contributing to neuronal damage.

Free radicals that are produced by membrane lipid degradation and mitochondrial dysfunction futher contribute to the neuronal damage in cerebrovascular accident.

There are two other factors that can accelerate the damage to the brain tissue during an acute CVD :

- Fever – worsens brain injury during ischemia
- Hyperglycemia - >200mg/dl.

This stresses the importance in controlling fever and the raised blood sugar levels in a CVD patient. Induced moderate hypothermia, is a topic still under reasearch, might reduce the brain damage.

RISK FACTORS:-

Common causes:

a. Increasing age

b. Obesity

c. Smoking

d. Systemic hypertension

e. Diabetes mellitus

f. Cardiac cause

g. Ischemic heart disease

h. Rheumatic heart disease

i. Infective endocarditis

j. Atrial fibrillation

k. Mitral valve prolapse

l. ASD- paradoxical embolus

m. Dyslipidemia

n. Hyperfibrinigenemia

o. High alcohol intake

p. Coagulopathies

q. Contraceptive pills

YOUNG STROKE:-

a. CARDIAC CAUSE

b. Metabolic syndrome

c. Vasculitis

d. Homocystenemia

e. Factor v mutation

f. Defeciency of protein C and S

g. Deficiency of anti thrombin III

h. AV malformation

i. Hematological causes

Less common causes:

Hypercoagulable state:

- SLE
- Anti phospholipid syndrome
- Deficiency of Protein C
- Deficiency of Protein S
- Factor V leiden mutation
- Deficiency of Anti thrombin III
- Polycythemia
- Thrombocytemia

- Homocystenemia

Venous sinus thrombosis:

- Pregnancy
- Post partum

Inflammatory bowel disease

Intracranial infections

FIBROMUSCULAR DYSPLASIA

TEMPORAL ARTERITIS

NECROTISING ARTERITIS

NEPHROTIC SYNDROME

VASCULITIS

DRUGS – Amphetamines

MOYA MOYA DISEASE

MELAS- Mitochondrial cytopathy

EHLERS DANLOS SYNDROME

CVD EPIDIOMOLOGY IN INDIA:-

India the fast developing country now face dual burden namely communicable disease(CD) and NCD. The prevalence rate (adjusted) of CVD varies from 88-262 per 100000in rural population and 334-424 per lakh in urban population.

Incident rate is 120-145 per lakh, report based recent population West Bengal especially Kolkata have high incidence of case fatality rate. In TAMIL NADU the prevalence is about 56.9 per lakh population. Shockingly 25% of CVD in Tamil Nadu involves patients with age less than 45 years. Though **"STROKE UNITS"** are formed in India they are not fully equiped to be functional. In Tamil Nadu only few stroke units carry out thrombolysis in stroke.

CLINICAL FEATURES :-

Signs and symptoms depends upon the regions of the brain where ischemia occurred. CVD should be considered in any patient presenting with abrupt onset of neurologic deficit or alteration in the conscious level. History and clinical examination may not help much to differentiate between the ischemic and hemorrhagic stroke.

Worsening of symptoms within short time of onset, conscious level depressed to the least level, elevated blood pressure ,seizures, signs of increased intra cranial pressure due to mass effect may favour hemorrhagic CVD.

The clinical features may be:

- Motor.
- Sensory.
- Autonomic.
- With cranial nerve involvement.

Fig: CIRCLE OF WILLIS

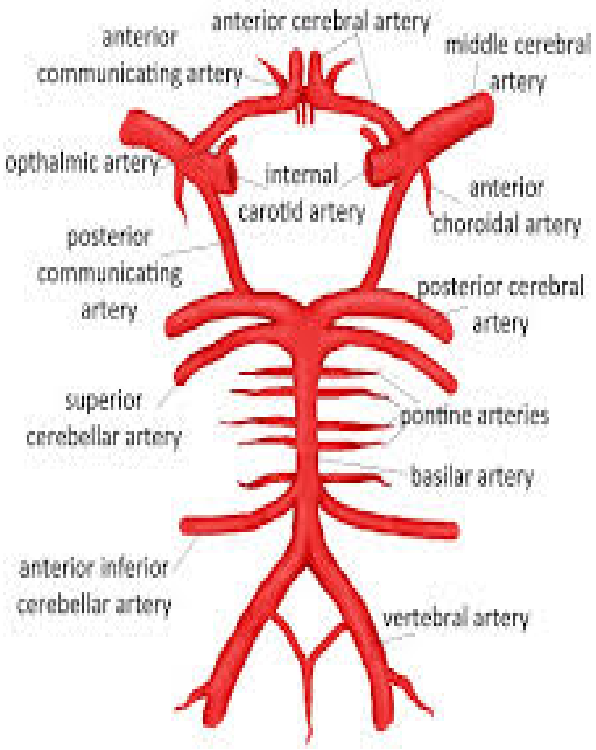
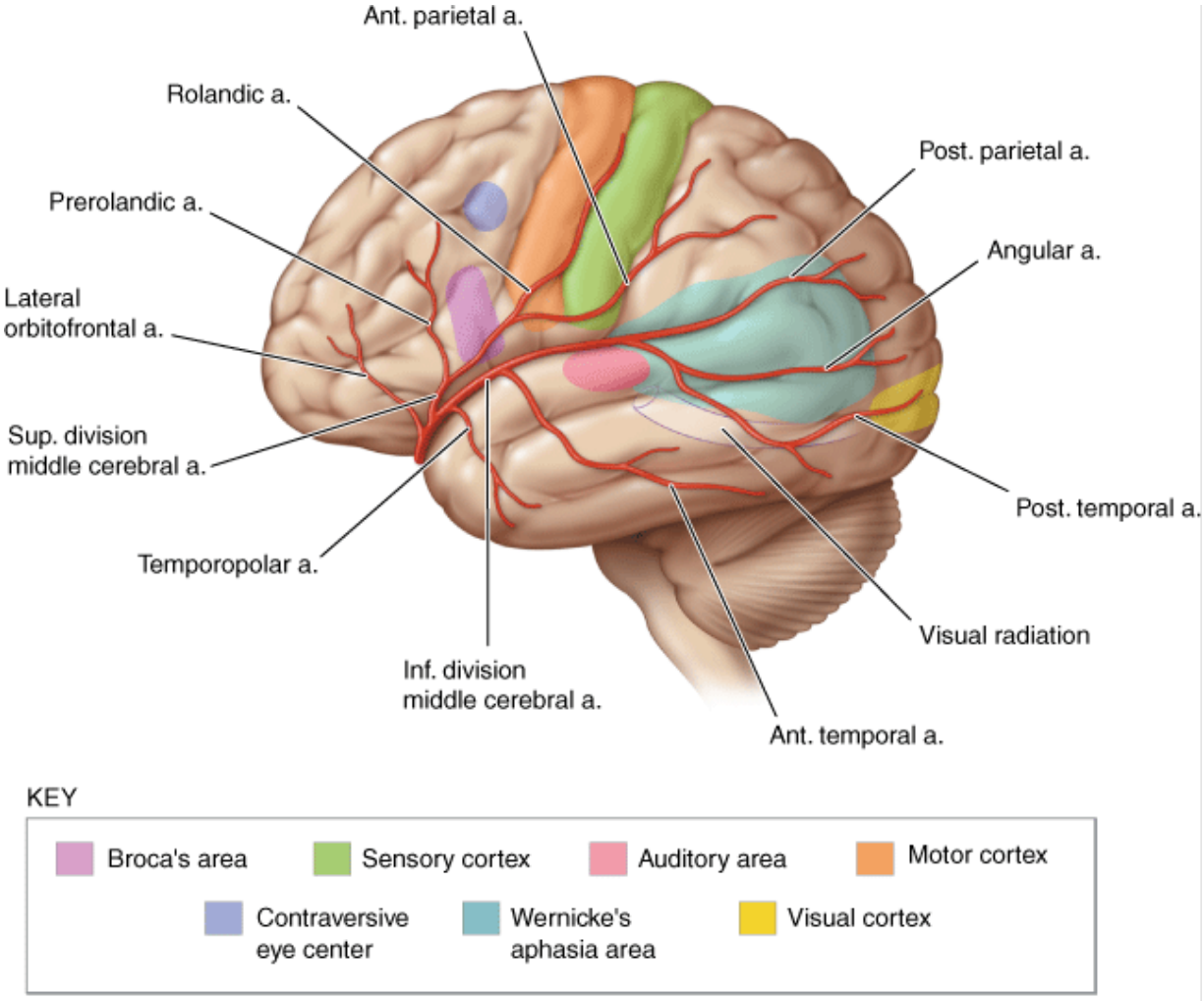
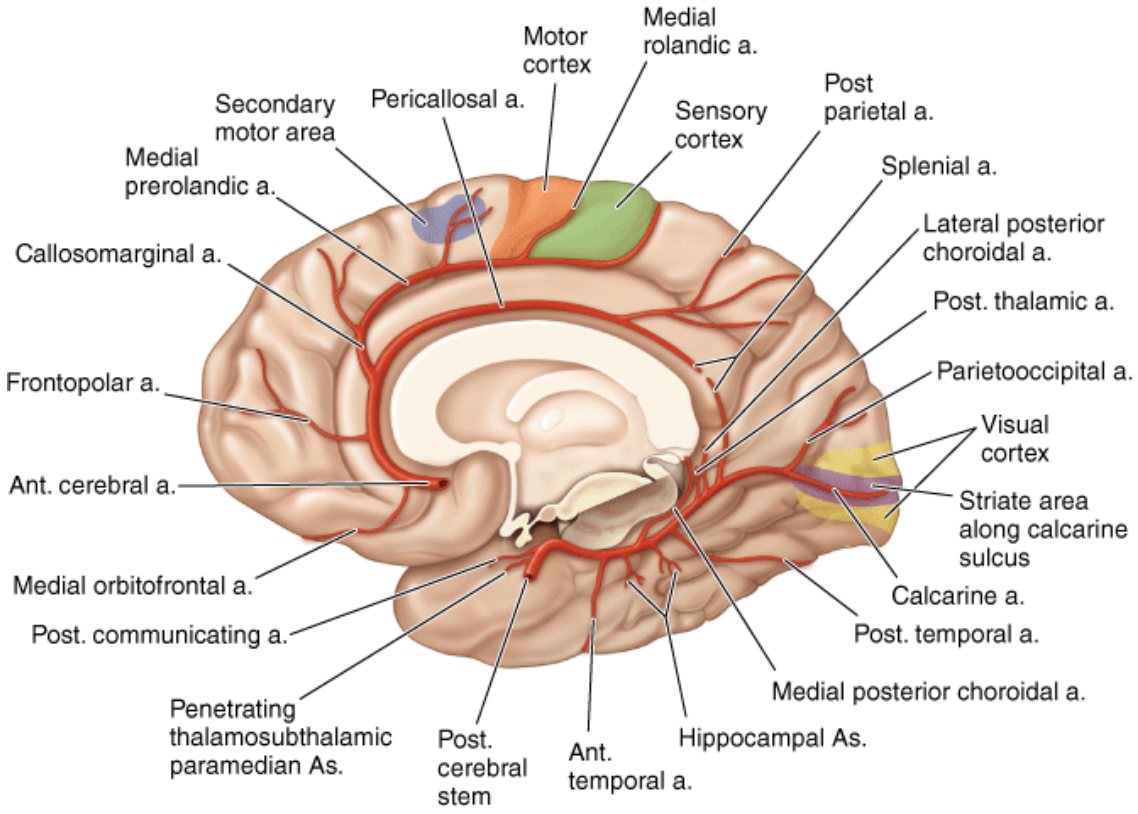


Fig: BLOOD SUPPLY OF THE LATERAL SURFACE



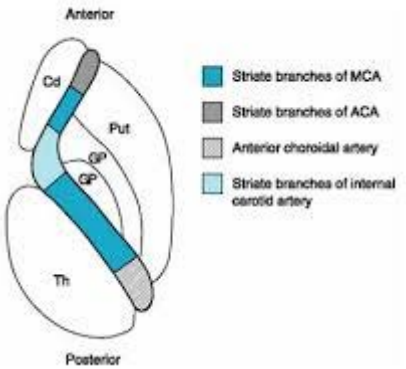
Source: Fauci AS, Kasper DL, Braunwald E, Hauser SL, Longo DL, Jameson JL, Loscalzo J: *Harrison's Principles of Internal Medicine*, 17th Edition: http://www.accessmedicine.com

Fig: BLOOD SUPPLY OF THE MEDIAL SURFACE



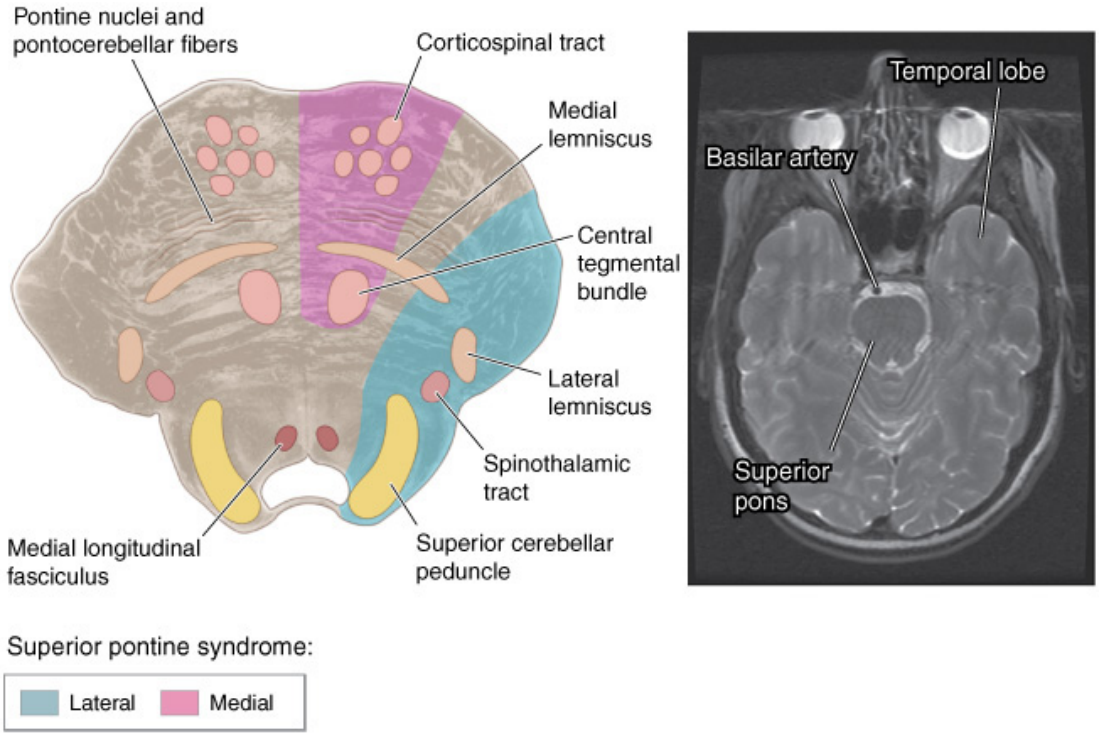
Source: Fauci AS, Kasper DL, Braunwald E, Hauser SL, Longo DL, Jameson JL, Loscalzo J: *Harrison's Principles of Internal Medicine*, 17th Edition: http://www.accessmedicine.com

Fig: BLOOD SUPPLY OF INTERNAL CAPSULE



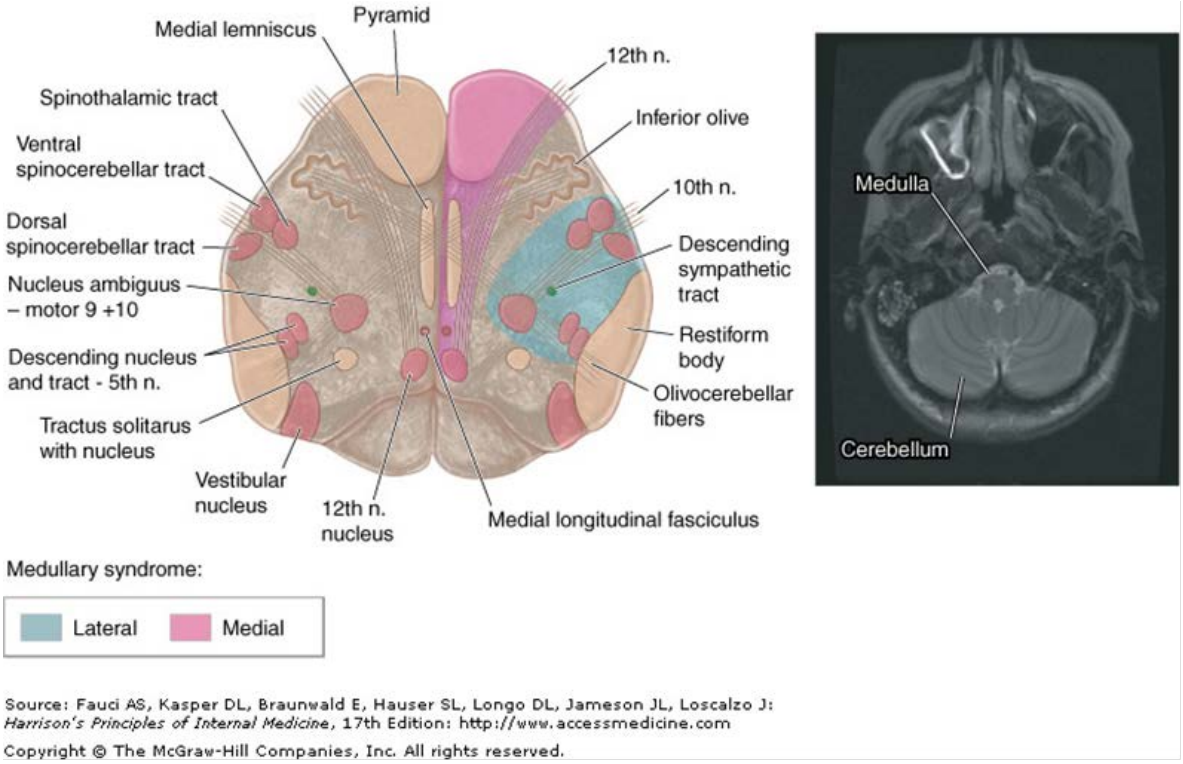
BRAIN STEM SYNDROME:-

Fig:PONTINESYNDROME



Source: Fauci AS, Kasper DL, Braunwald E, Hauser SL, Longo DL, Jameson JL, Loscalzo J: *Harrison's Principles of Internal Medicine*, 17th Edition: http://www.accessmedicine.com

Fig:MEDULLARYSYNDROME



MANIFESTATIONS OF CAROTID ARTERY STROKE:-

- Visual disturbance involving single eye
- Speech disturbance
- Cortical type of hemi-anaesthesia
- Recuurent TIA'S
- Carotid bruit and
- Stuterring hemiplegia

MANIFESTATIONS OF VERTEBROBASILARY STROKE:-

- Diplopia
- Cortical blindness
- Thalamic syndrome
- Drop attacks
- Dysphagia/ dysarthria
- Double hemiplegia
- Dizziness
- Lower cranial nerve involvement.

DIFFERENTIAL DIAGNOSIS:-

- ✓ Post seizure paralysis – Todd's paralysis
- ✓ Migraine with neurological deficit
- ✓ Metabolic cause- hypoglycaemia
- ✓ Hypertensive encephalopathy
- ✓ Mass lesions

DIAGNOSTIC TESTING:-

Laboratories:-

In acute setting for thrombolytic therapy

- CBC with platelets
- PT / INR
- aPTT
- Blood glucose

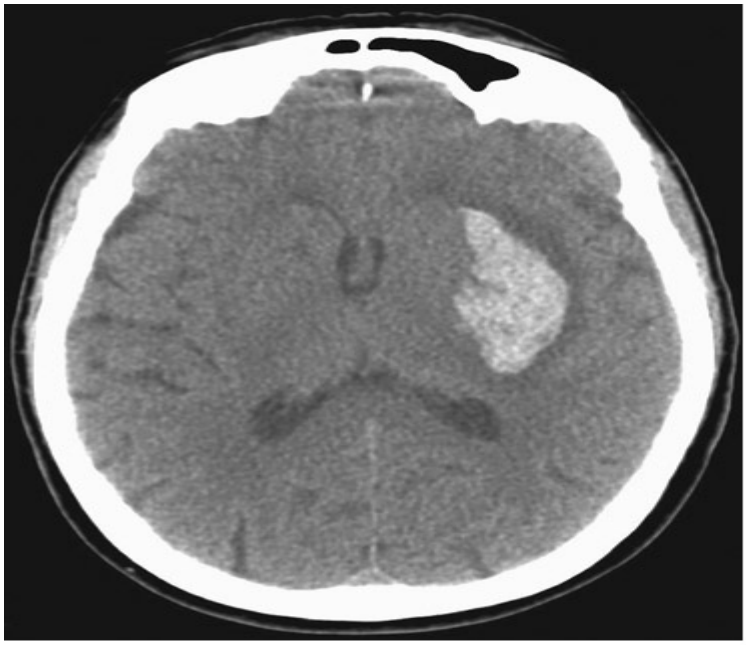
For evaluation

- Lipid profile
- HgbA1c
- ESR
- Blood cultures
- ANA
- HIV
- Anti phospolipid antibody and SLE antibodies
- Serum electrolytes

ECG

IMAGING:-

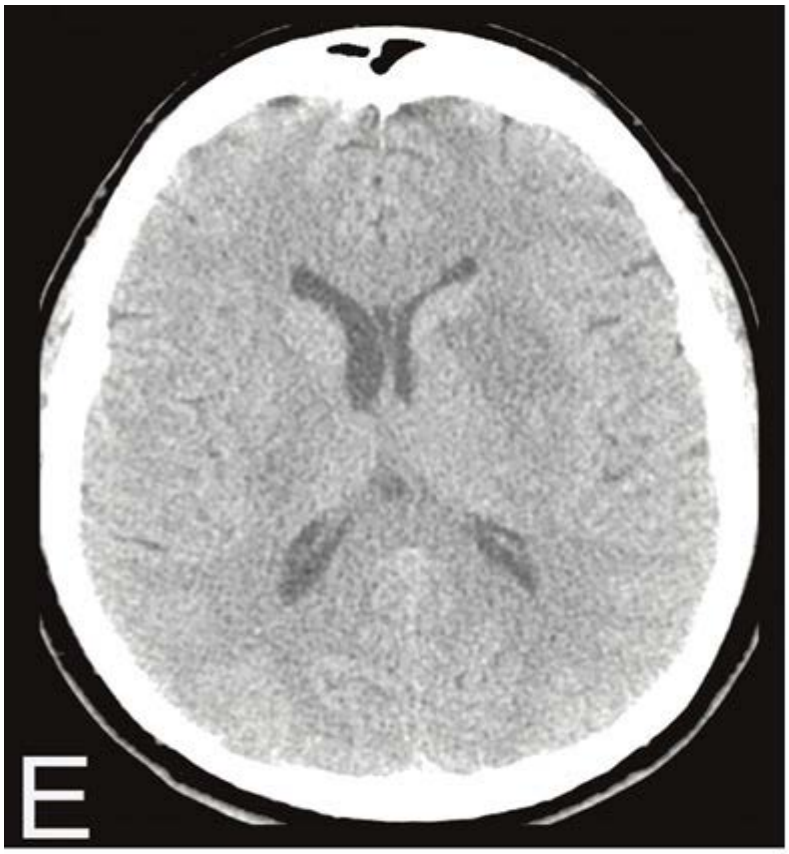
Non-contrast CT – to differentiate intra cranial hemmorhage from the ischemia



EARLY RADIOLOGICAL CLUES FOR ISCHEMIC STROKE:

- ✓ Insular ribbon sign (loss of definition of grey-white interface in the lateral margins of the insula due to oedema in the insular cortex).
- ✓ Hyperdense middle cerebral artery sign.
- ✓ Hypoattenuation in the lentiform nucleus.
- ✓ Sulcal obliteration and Loss of grey-white matter differentiation.

Fig: ISCHEMIC STROKE:-



MRI:–

- ✓ Most sensitive investigation of choice for CVD DIAGNOSIS.
- ✓ Diffusion weighted MRI detect stroke the earliest.
- ✓ In diagnosis of Posterior stroke.
- ✓ SEQUENCE IMAGING MRI detects intra and extra cranial arterial dissection.
- ✓ MRA/MRV detect occlusion involving the large artery and veins.

CAROTID DOPPLER-

non-invasive estimation of carotid stenosis for anterior circulatory stroke.

2D-TT-ECHO for intra cardiac thrombus, valve vegetations, valvular insufficiency and stenosis.

TEE may be needed sometimes for left atrial thrombus.

DIAGNOSTIC PROCEDURE:-

CEREBRAL ANGIOGRAM – DEFINITE STUDY for malformation of vascular structures and for performing end arterectomy of Carotid (CEA)

LUMBAR PUNCTURE – if CT negative and high suspicion of SAH, LP is done. Tubes 1 and 4 should be sent for cell count. Dramatic decrease of RBC from 1 to 4 tube indicate traumatic LP more likely than SAH. Xanthochromia resulting from RBC lysis after centrifuging indicates SAH rather than traumatic

MANAGEMENT OF CVD:-

1) MEDICAL SUPPORT

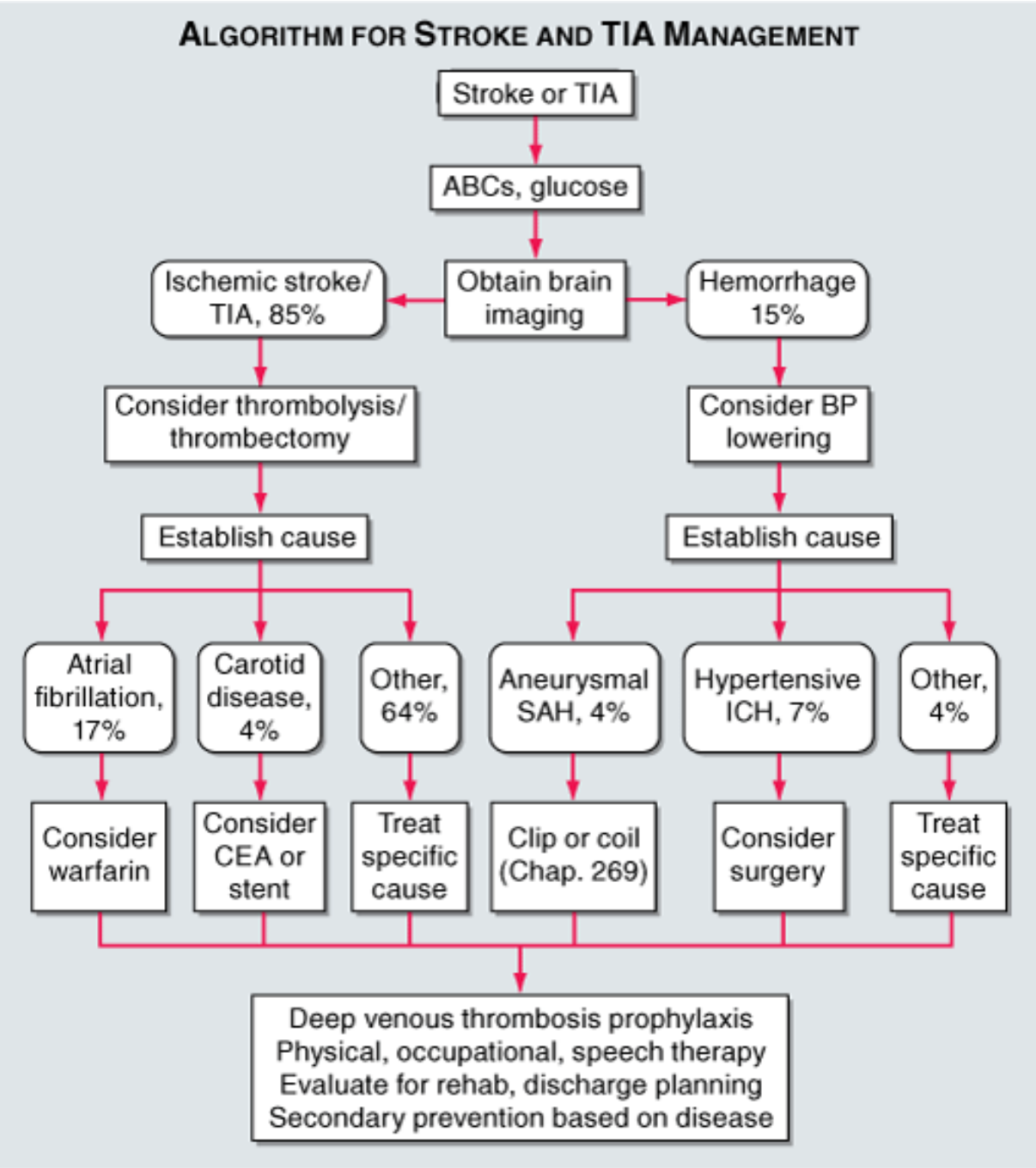
2) INTRAVENOUS THROMBOLYSIS

3) ENDOVASCULAR TECHNIQUES

4) ANTITHROMBOTIC TREATMENT

5) NEUROPROTECTION

6) STROKE CENTRES AND REHABILITATION



METHODOLOGY

STUDY:

ASSOCIATION OF SERUM URIC ACID LEVELS IN ACUTE ISCHEMIC STROKE

OBJECTIVES:

1. The study is conducted to analyse the association between serum uric acid levels and acute ischemic stroke and to asses its risk factor potential.
2. To study the association between serum uric acid levels and other risk factors mainly hypertension, DM, CAD and lipid profile.

TYPE OF STUDY: Analytical Cross Sectional Study

STUDY POPULATION: Patients admitted in Govt. Royapettah Hospital with first time acute ischemic stroke.

Inclusion criteria:

Patients with 1st time acute ischemic stroke

Exclusion criteria:

- ✓ Previous H/o TIA, CVA
- ✓ Patients on Thiazide diuretics
- ✓ Patients with Malignancies
- ✓ Patients who are a known case of gout or have clinical evidence of gout
- ✓ Patients with chronic renal failure
- ✓ Patients with hemorrhagic stroke

SAMPLE SIZE: As per formula for calculating sample size, sample size was found to be 50.

METHODOLOGY:

After obtaining consent from the patient, Serum uric acid levels will be checked in cases of acute ischemic stroke.

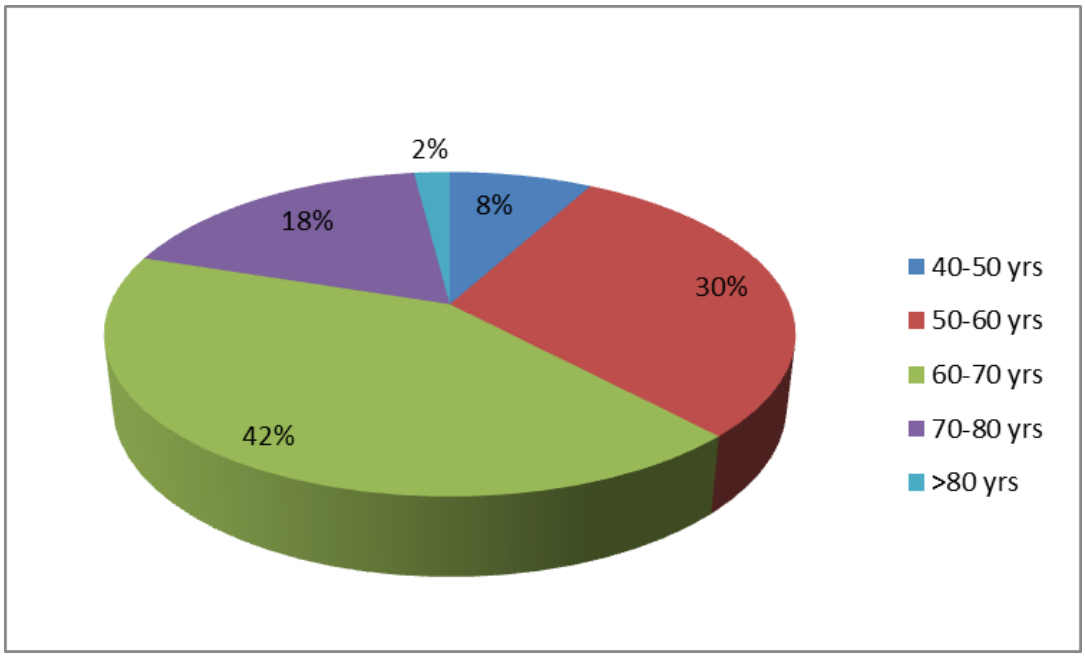
Other risk factors including DM, Hypertension and hyperlipidemia will be evaluated with appropriate lab investigations.

Association between uric acid levels and acute ischemic stroke will be analysed. The association between uric acid levels and other risk factors will also be looked for.

TABLE-1: AGE DISTRIBUTION OF THE STUDY POPULATION

AGE GROUP	FREQUENCY	PERCENT
40-50	4	8%
50-60	15	30%
60-70	21	42%
70-80	9	18%
> 80	1	2%
Total	50	100%

PIE DIAGRAM SHOWING AGE DISTRIBUTION OF THE STUDY POPULATION

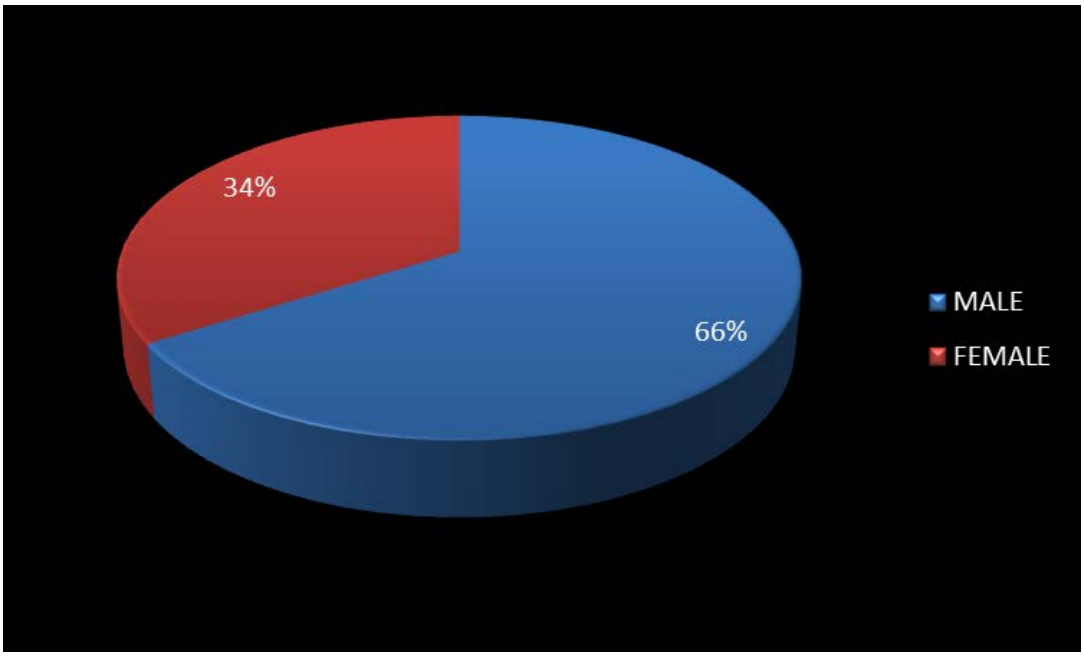


Majority of the study subjects where between the age group of 60-70 years that is around 42%. 30% of the study subjects where in the age group of 50-60 years. 18% of the study subjects are in the age group of 70-80 years. 8% of the study subjects are in 40-50 years and the remaining 2% are in the age group of 80 and above.

Table 2: SEX DISTRIBUTION OF THE STUDY POPULATION

SEX	FREQUENCY	PERCENT
Male	33	66 %
Female	17	34 %
Total	**50**	**100%**

PIE DIAGRAM SHOWING SEX DISTRIBUTION OF STUDY POPULATION

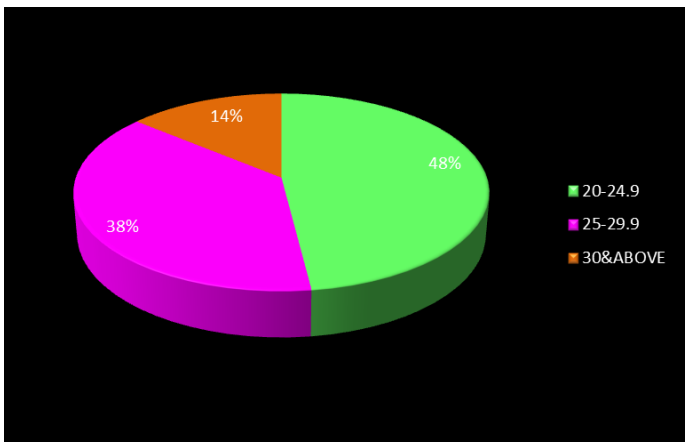


Majority of the study subjects where females which is around 66% and the males were around 34%.

Table 3: DISTRIBUTION OF THE STUDY POPULATION BASED ON BMI STATUS

BMI STATUS	FREQUENCY	PERCENT
20-24.9	24	48%
25-29.9	19	38%
>= 30	7	14%
Total	50	100

PIE DIAGRAM SHOWING DISTRIBUTION BASED ON BMI STATUS

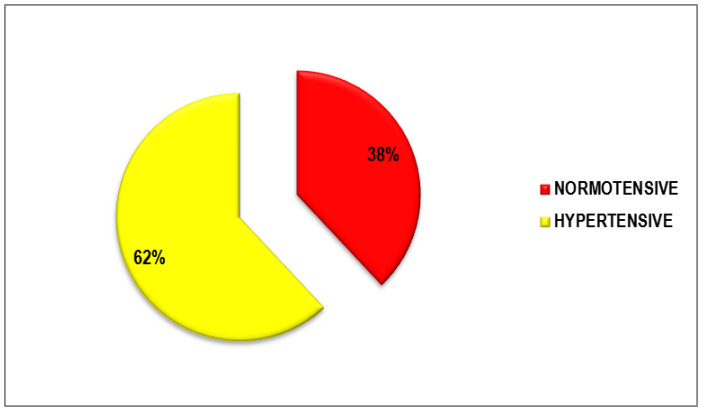


Majority of the study subjects where in the BMI status 20-24.9 , which is around 48%. 38% of the study subjects where in the BMI status 25-29.9. And the remaining 14% of the study subjects are in the BMI status 30 and above.

Table 4: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO HYPERTENSION

HYPERTENSION	FREQUENCY	PERCENT
Yes	19	38%
No	31	62%
Total	**50**	**100%**

PIE DIAGRAM SHOWING NUMBER OF HYPERTENSION

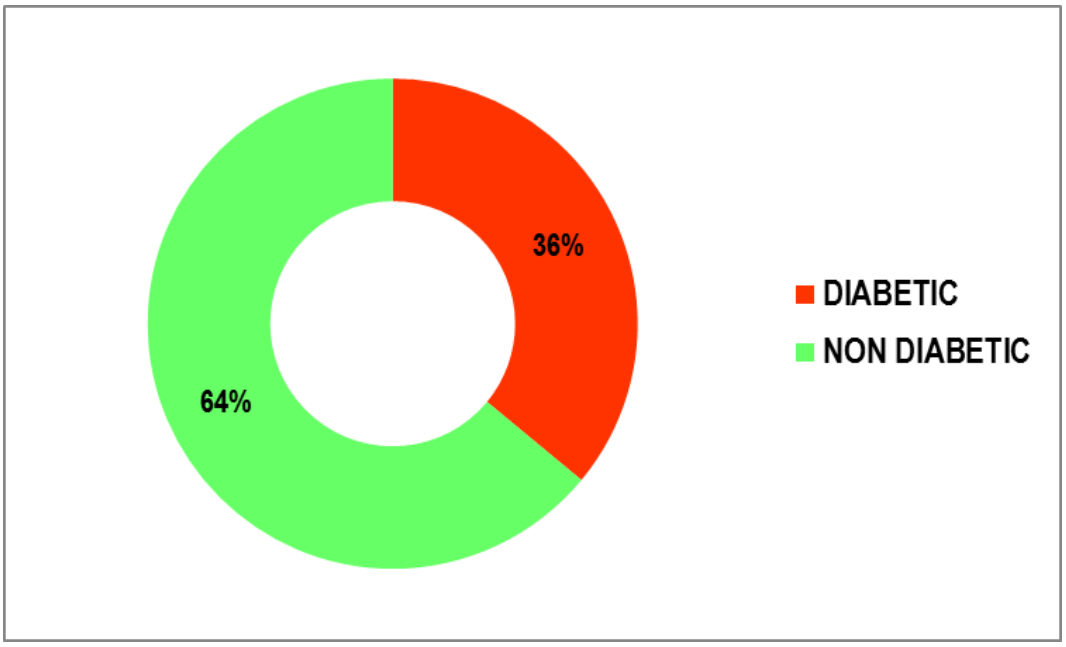


Majority of the study population are hypertensive which where around 62% .the remaining 38% were normotensive.

TABLE 5: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO DIABETES MELLITUS

DIABETES MELLITUS	FREQUENCY	PERCENT
Yes	18	36
No	32	64
Total	**50**	**100**

DIAGRAM SHOWING DISTRIBUTION ACCORDING TO DIABETES MELLITUS

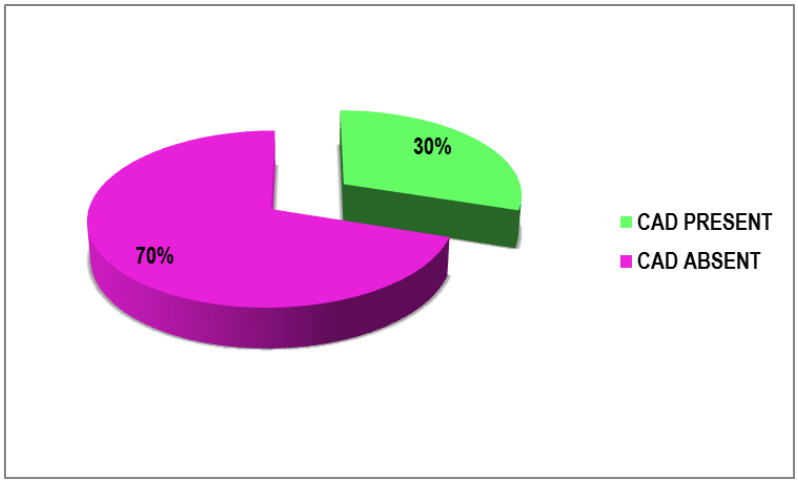


Majority of the study subjects where non-diabetic which where around 64%. The remaining 36% were diabetic.

TABLE 6: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO CORONARY ARTERY DISEASE

CORONARY ARTERY DISEASE	FREQUENCY	PERCENT
Yes	15	30.0
No	35	70.0
Total	**50**	**100.0**

PIE DIAGRAM SHOWING THE DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO CORONARY ARTERY DISEASE

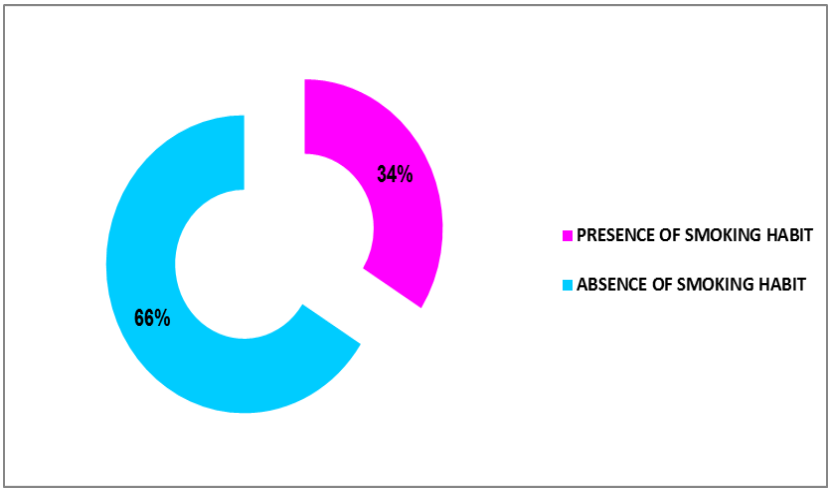


Majority of the study subjects have no coronary artery disease which where around 70%. The remaining 30% of the study population have coronary artery disease.

TABLE 7: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO SMOKING HABIT

SMOKING HABIT	FREQUENCY	PERCENT
YES	17	34%
NO	33	66%
TOTAL	**50**	**100%**

DIAGRAM SHOWING DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO SMOKING HABIT

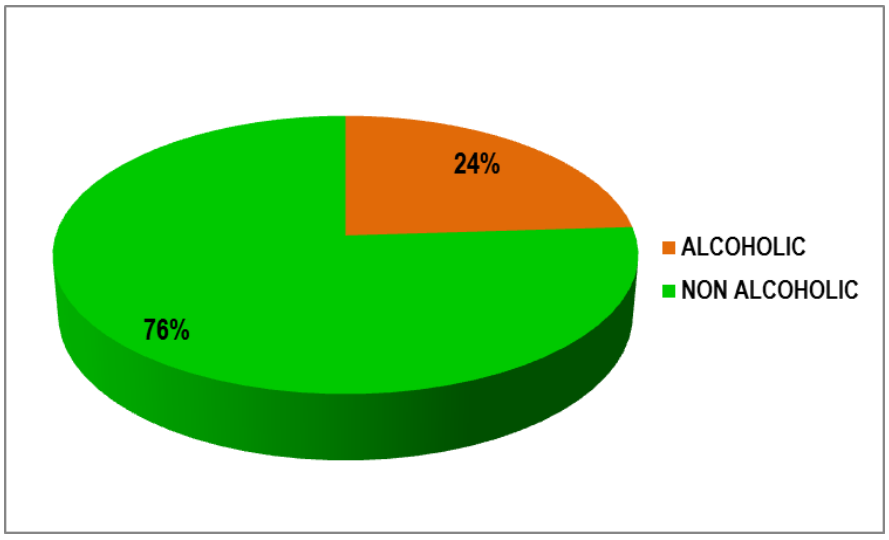


Majority of the study subjects are non – smokers which where around 66%. The remaining 34% of the study subjects were smokers .

TABLE 8: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO ALCOHOL CONSUMPTION

ALCOHOL CONSUMPTION	FREQUENCY	PERCENT
Yes	12	24%
No	38	76%
Total	**50**	**100%**

PIE DIAGRAM SHOWING THE DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO ALCOHOL INTAKE

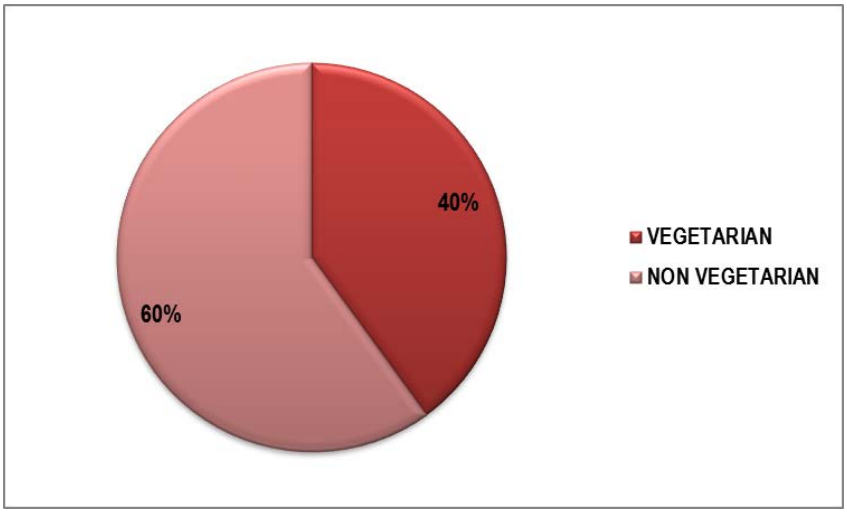


Majority of the study subjects are non – alcoholic which where around 76%. The remaining 24% were alcoholics.

TABLE 9: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO DIET PATTERN

DIET PATTERN	FREQUENCY	PERCENT
Vegeterian	20	40
Non- Vegeterian	30	60
Total	**50**	**100.0**

PIE DIAGRAM SHOWING DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO DIET PATTERN

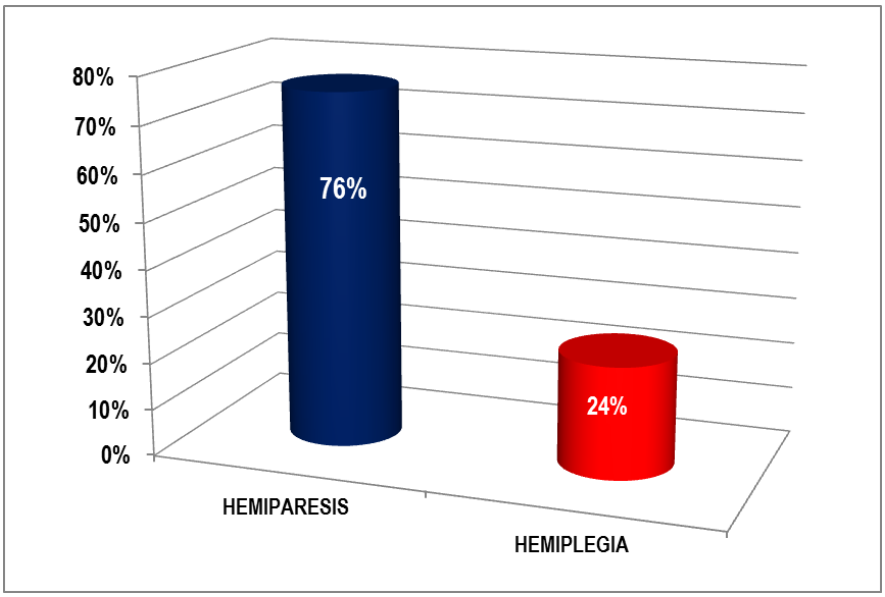


Majority of the study subjects are non-vegetarians which where around 60% . The remaining 40% were vegetarians.

TABLE 10: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO CVA

TYPE OF CVA	FREQUENCY	PERCENT
Hemiparesis	38	76.0
Hemiplegia	12	24.0
TOTAL	**50**	**100.0**

BAR DIAGRAM SHOWING DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO CVA

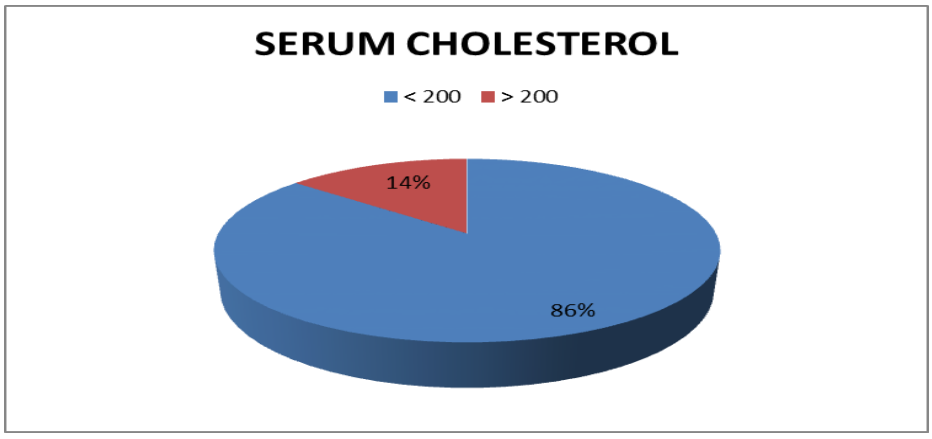


Majority of the study subjects are having Hemiparesis which where around 76%. The remaining 24% of the study subjects are having hemiplegia.

TABLE 11: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO SERUM.CHOLESTEROL

SERUM CHOLESTEROL	FREQUENCY	PERCENT
< 200	43	86.0
> 200	7	14.0
Total	**50**	**100.0**

PIE DIAGRAM SHOWING DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO SERUM CHOLESTEROL

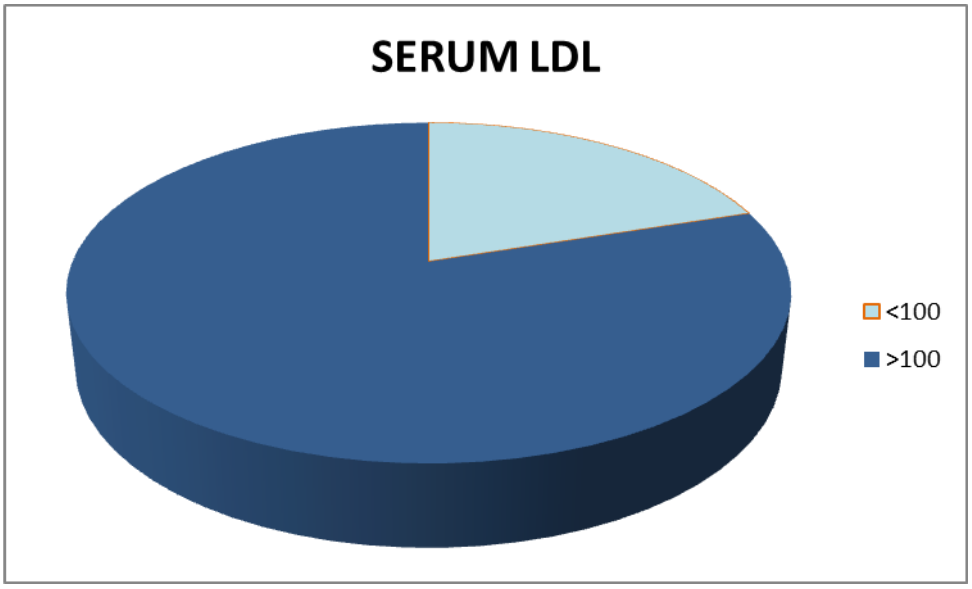


Majority of the study subjects have serum cholesterol level <200 mg/dl which where around 86%. The remaining 14% of the study subjects have elevated serum cholesterol value.

TABLE 12: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO LDL LEVEL

LDL	FREQUENCY	PERCENT
< 100	10	20.0
> 100	40	80.0
Total	**50**	**100.0**

DIAGRAM SHOWING: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO LDL LEVEL

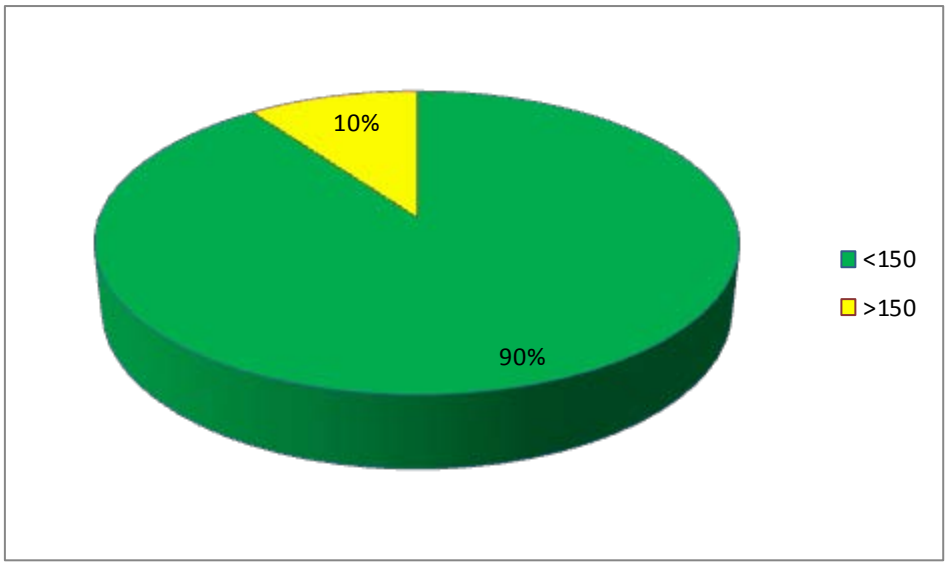


Majority of the study population having elevated LDL values which where around 80% .The remaining 20% have normal LDL values.

TABLE 13: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO TGL VALUES

TGL	FREQUENCY	PERCENT
< 150	45	90.0
> 150	5	10.0
Total	**50**	**100.0**

PIE DIAGRAM SHOWING DISTRIBUTION OF STUDY POPULATION ACCORDING TO TGL LEVEL

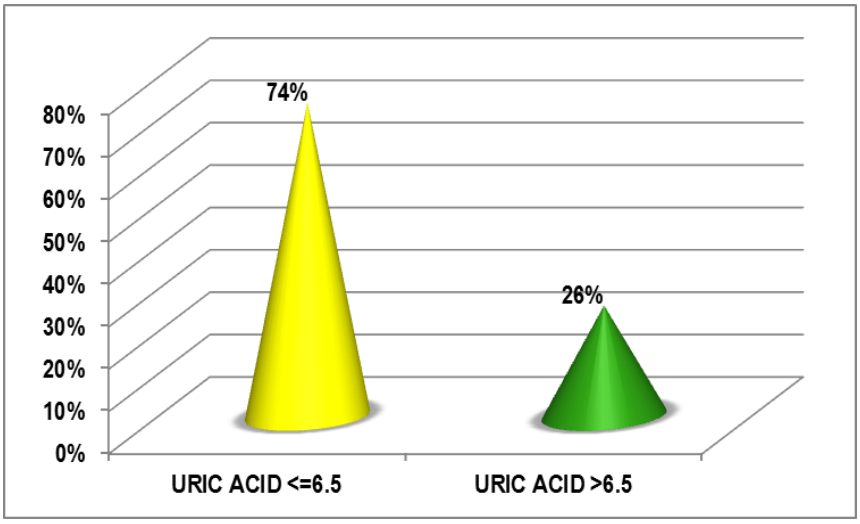


Majority of the study subjects are having TGL values normal which where around 90%. The remaining10% of the study subjects have elevated TGL levels.

TABLE 14: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO SUA

URIC ACID	FREQUENCY	PERCENT
<= 6.5	37	74.0
> 6.5	13	26.0
Total	**50**	**100.0**

BAR DIAGRAM SHOWS: DISTRIBUTION OF THE STUDY POPULATION ACCORDING TO SUA



Majority of the study subjects have SUA =<6.5 mg/dl which where around 74%. The remaining 26% of the study subjects have elevated SUA .

Table 15: CROSS TABULATION BETWEEN DM AND SUA

Crosstab

			Uric Acid		Total	P value
			<= 6.5	> 6.5		
DM	Yes	Count	9	9	18	0.004**
		% within DM	50.0%	50.0%	100.0%	
		% within Uric Acid	24.3%	69.2%	36.0%	
	No	Count	28	4	32	
		% within DM	87.5%	12.5%	100.0%	
		% within Uric Acid	75.7%	30.8%	64.0%	
Total		Count	37	13	50	
		% within DM	74.0%	26.0%	100.0%	
		% within Uric Acid	100.0 %	100.0%	100.0%	

p value 0 .004

Among the study subjects 74% had SUA less than 6.5 mg/dl compared to 26% of the study subjects have elevated SUA (>6.5 mg/dl). It is evident from the study that 50% diabetic patients had there. SUA < 6.5 compared to 50% diabetic with elevated SUA.

In contrast 87.5% the non diabetic patients have SUA <6.5 and 12.5% of the non diabetics have SUA > 6.5. This difference was found to be statistically significant.

BAR DIAGRAM SHOWING CORRELATION BETWEEN DM AND SUA

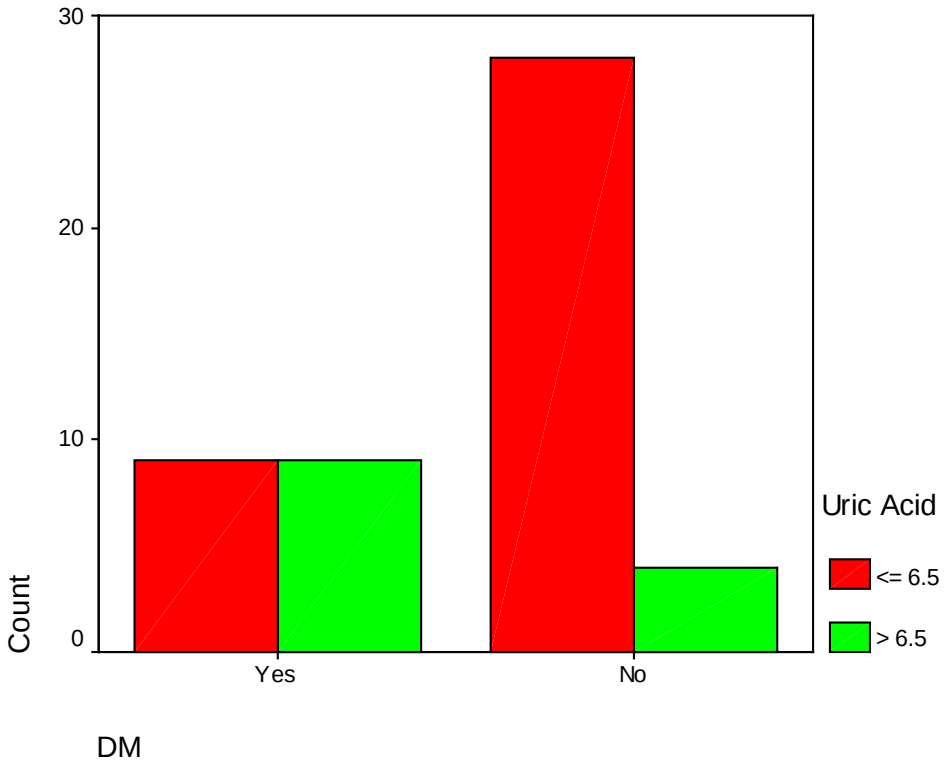


Table 16: CROSS TABULATION BETWEEN CAD AND SUA

Crosstab

			Uric Acid		
			<= 6.5	> 6.5	Total
CAD	Yes	Count	8	7	15
		% within CAD	53.3%	46.7%	100.0%
		% within Uric Acid	21.6%	53.8%	30.0%
	No	Count	29	6	35
		% within CAD	82.9%	17.1%	100.0%
% within Uric Acid		78.4%	46.2%	70.0%	
Total		Count	37	13	50
		% within CAD	74.0%	26.0%	100.0%
		% within Uric Acid	100.0%	100.0%	100.0%

p value 0.029

Among the study subjects 74% had SUA less than 6.5 mg/dl compared to 26% of the study subjects have elevated SUA (>6.5 mg/dl).It is evident from the study that 53.3% CAD patients had there SUA < 6.5compared to 46.7% of the CAD patients with elevated SUA .

In contrast 82.9% the non CAD subjects have SUA <6.5 and 17.1% of the non CAD subjects have SUA > 6.5. This difference was found to be statistically significant.

BAR DIAGRAM SHOWING CORRELATION BETWEEN CAD AND SUA

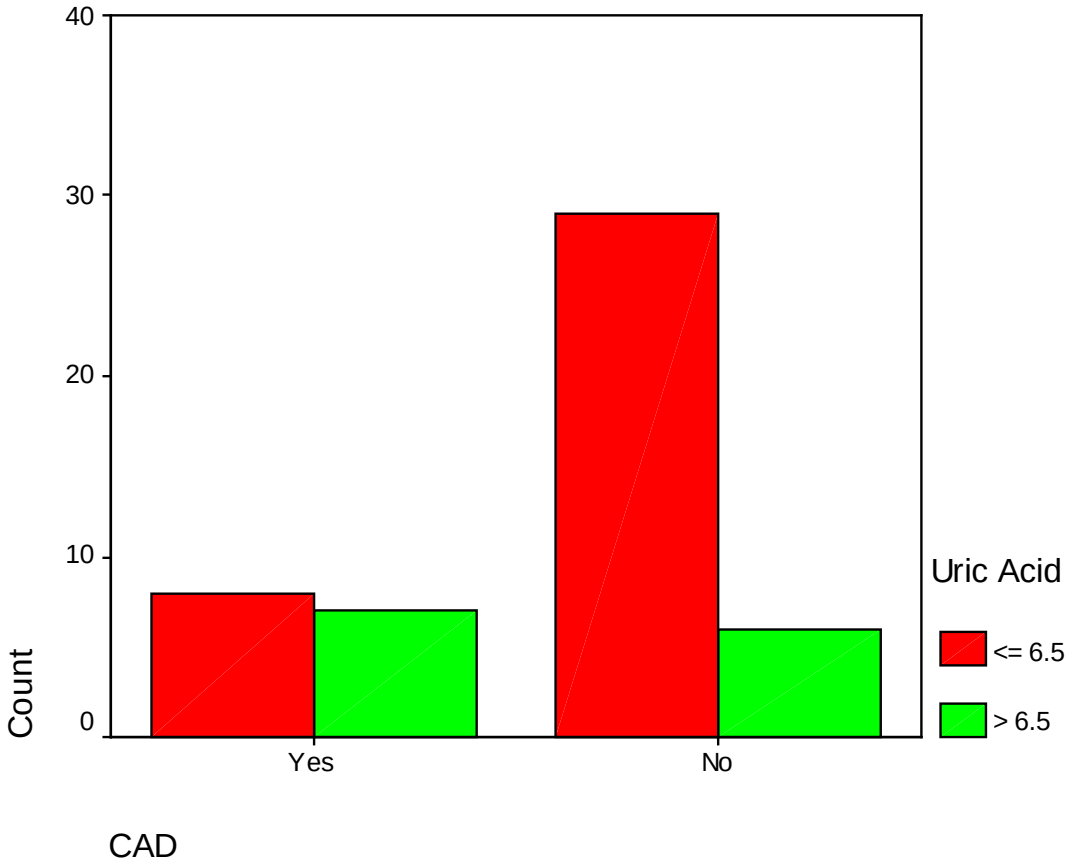


Table 17: CROSS TABULATION BETWEEN SMOKING AND SUA

Crosstab

			Uric Acid		
			<= 6.5	> 6.5	Total
Smoking	Yes	Count	11	6	17
		% within Smoking	64.7%	35.3%	100.0%
		% within Uric Acid	29.7%	46.2%	34.0%
	No	Count	26	7	33
		% within Smoking	78.8%	21.2%	100.0%
% within Uric Acid		70.3%	53.8%	66.0%	
Total		Count	37	13	50
		% within Smoking	74.0%	26.0%	100.0%
		% within Uric Acid	100.0%	100.0%	100.0%

p value 0.282

Among the study subjects 74% had SUA less than 6.5 mg/dl compared to 26%

of the study subjects have elevated SUA (>6.5 mg/dl).It is evident from the study that 64.7% smoking patients had there SUA < 6.5 compared to32.5% of the smoking patients with elevated SUA . In contrast 78.8% of the non smoking subjects have SUA <6.5 and 21.2% of the non smoking subjects have SUA > 6.5. This difference was found to be statistically in significant.

BAR DIAGRAM SHOWING CORRELATION BETWEEN SMOKING AND SUA

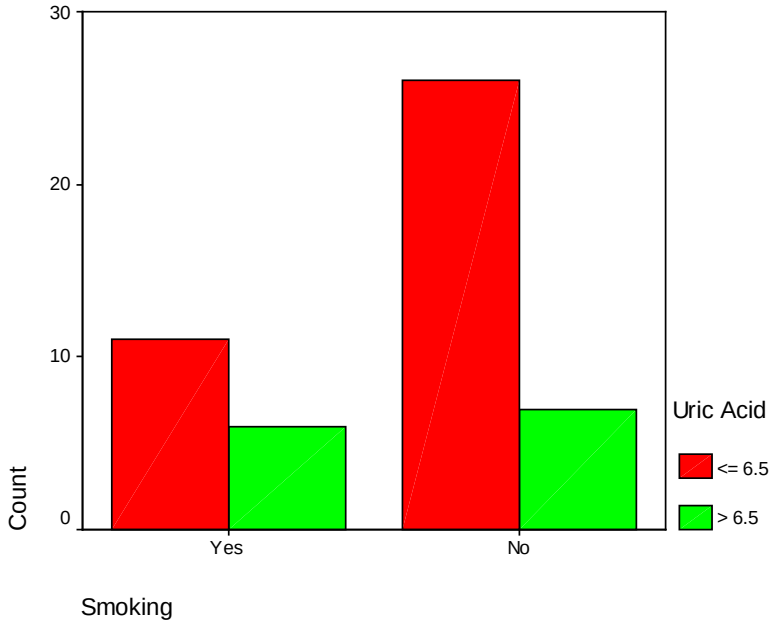


Table 18 : CROSS TABULATION BETWEEN ALCOHOL AND SUA

Crosstab

			Uric Acid		
			<= 6.5	> 6.5	Total
Alcohol	Yes	Count	5	7	12
		% within Alcohol	41.7%	58.3%	100.0%
		% within Uric Acid	13.5%	53.8%	24.0%
	No	Count	32	6	38
		% within Alcohol	84.2%	15.8%	100.0%
% within Uric Acid		86.5%	46.2%	76.0%	
Total		Count	37	13	50
		% within Alcohol	74.0%	26.0%	100.0%
		% within Uric Acid	100.0%	100.0%	100.0%

p value 0.003

Among the study subjects 74% had SUA less than 6.5 mg/dl compared to 26% of the study subjects have elevated SUA (>6.5 mg/dl).It is evident from the study that 41.7% of alcoholic patients had there SUA < 6.5 compared to58.3% of the alcoholic patients with elevated SUA .

In contrast 84.2% of the non alcoholic subjects have SUA <6.5 and 15.8% of the non alcoholic subjects have SUA > 6.5. This difference was found to be statistically significant.

BAR DIAGRAM SHOWING CORRELATION BETWEEN ALCOHOL AND SUA

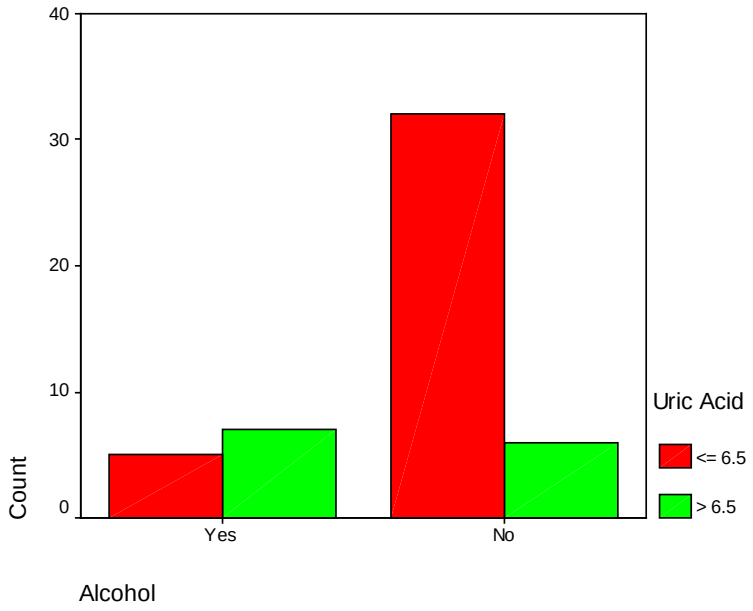


Table 19: CROSS TABULATION BETWEEN DIET AND SUA

			Uric Acid		
			<= 6.5	> 6.5	Total
Diet	Vegeterian	Count	18	2	20
		% within Diet	90.0%	10.0%	100.0%
		% within Uric Acid	48.6%	15.4%	40.0%
	Non-Vegeterian	Count	19	11	30
		% within Diet	63.3%	36.7%	100.0%
% within Uric Acid		51.4%	84.6%	60.0%	
Total		Count	37	13	50
		% within Diet	74.0%	26.0%	100.0%
		% within Uric Acid	100.0%	100.0%	100.0%

p value 0.035

Among the study subjects 74% had SUA less than 6.5 mg/dl compared to 26% of the study subjects have elevated SUA (>6.5 mg/dl).It is evident from the study that 90% of vegetarian patients had there SUA < 6.5 compared to10% of the vegetarian patients with elevated SUA .

In contrast 63.3% of the non vegetarian subjects have SUA <6.5 and 36.7% of the non vegetarian subjects have SUA > 6.5. This difference was found to be statistically significant.

BAR DIAGRAM SHOWING CORRELATION BETWEEN DIET AND SUA

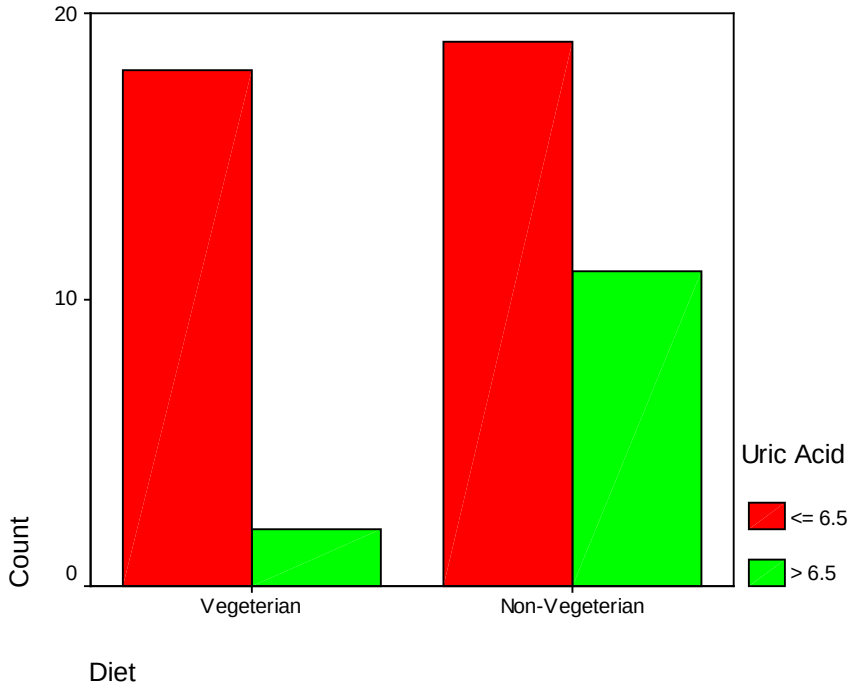


Table:20 CROSS TABULATION BETWEEN TYPE OF CVA AND SUA

			Uric Acid		
			<= 6.5	> 6.5	Total
Type of CVA	Hemiparesis	Count	37	1	38
		% within Type of CVA	97.4%	2.6%	100.0%
		% within Uric Acid	100.0%	7.7%	76.0%
	Hemiplegia	Count	0	12	12
		% within Type of CVA	.0%	100.0%	100.0%
% within Uric Acid		.0%	92.3%	24.0%	
Total		Count	37	13	50
		% within Type of CVA	74.0%	26.0%	100.0%
		% within Uric Acid	100.0%	100.0%	100.0%

p value 0.000

Among the study subjects 74% had SUA less than 6.5 mg/dl compared to 26% of the study subjects have elevated SUA (>6.5 mg/dl).It is evident from the study that 97.4% Hemiparesis patients had there SUA < 6.5 compared to2.6% of the Hemiparesis patients with elevated SUA .

In contrast 0% of the Hemiplegia subjects have SUA <6.5 and 100% of the Hemiplegia subjects have SUA > 6.5. This difference was found to be statistically significant.

BAR DIAGRAM SHOWING CORRELATION BETWEEN TYPE OF CVA AND SUA

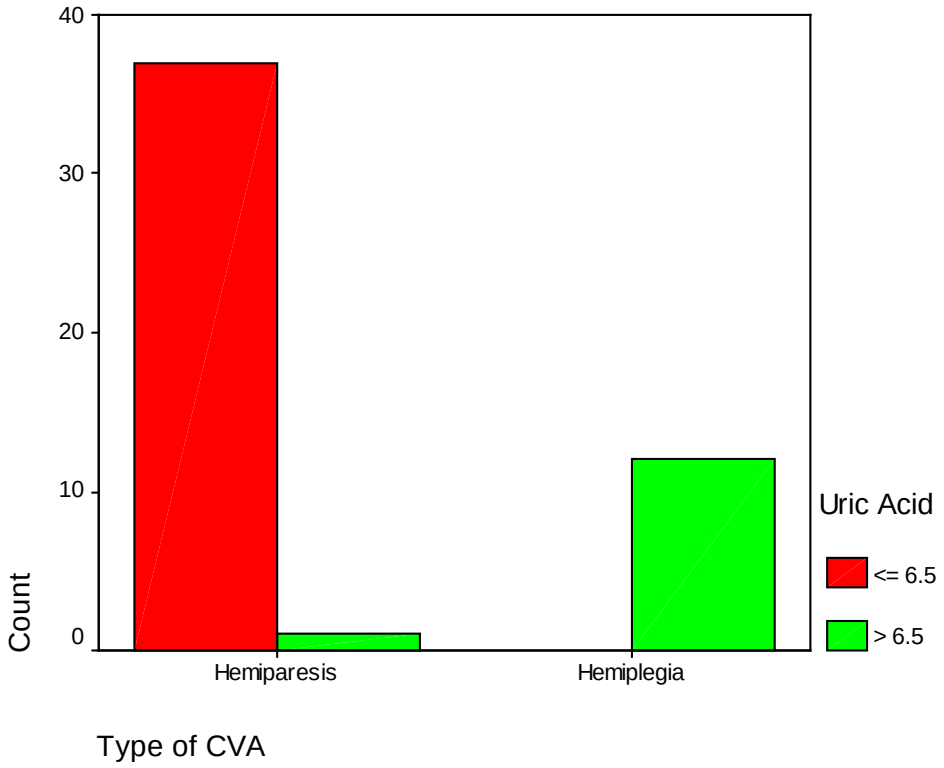


Table 21: CROSSTABULATION BETWEEN TOTAL CHOLESTEROL AND SUA

			Uric Acid		
			<= 6.5	> 6.5	Total
Total Cholesterol (Mg/Dl)	< 200	Count	36	7	43
		% within Total Cholesterol (Mg/Dl)	83.7%	16.3%	100.0%
		% within Uric Acid	97.3%	53.8%	86.0%
	> 200	Count	1	6	7
		% within Total Cholesterol (Mg/Dl)	14.3%	85.7%	100.0%
% within Uric Acid		2.7%	46.2%	14.0%	
Total		Count	37	13	50
		% within Total Cholesterol (Mg/Dl)	74.0%	26.0%	100.0%
		% within Uric Acid	100.0%	100.0%	100.0%

p value 0.000

Among the study subjects 74% had SUA less than 6.5 mg/dl compared to 26% of the study subjects have elevated SUA (>6.5 mg/dl).It is evident from the study that 83.7% of patients with total cholesterol (<200mg/dl) had there SUA < 6.5 compared to16.3% of the patients with total cholesterol (<200mg/dl) had elevated SUA .

In contrast 14.3% of the patients with total cholesterol (>200mg/dl) had SUA <6.5 and 85.7% of the patient with total cholesterol (>200mg/dl) had SUA > 6.5. This difference was found to be statistically significant.

BAR DIAGRAM SHOWING CORRELATION BETWEEN TOTAL CHOLESTEROL AND SUA

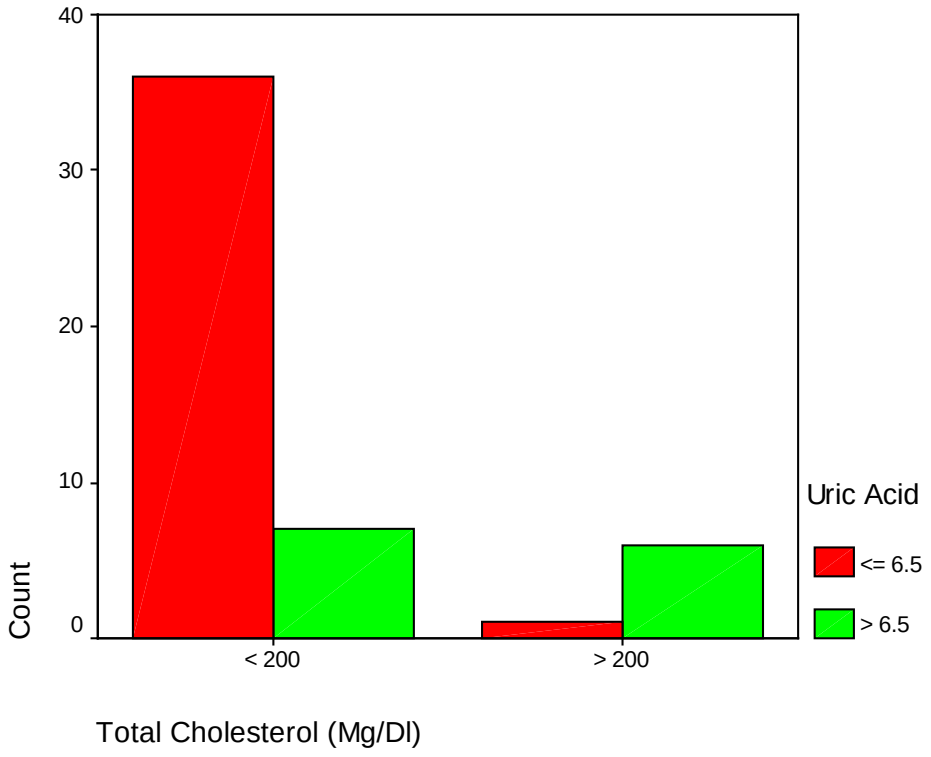


Table 22: CROSS TABULATION BETWEEN LDL AND SUA

			Uric Acid		
			<= 6.5	> 6.5	Total
LDL (MG/DL)	< 100	Count	10	0	10
		% within LDL (MG/DL)	100.0%	.0%	100.0%
		% within Uric Acid	27.0%	.0%	20.0%
	> 100	Count	27	13	40
		% within LDL (MG/DL)	67.5%	32.5%	100.0%
% within Uric Acid		73.0%	100.0%	80.0%	
Total		Count	37	13	50
		% within LDL (MG/DL)	74.0%	26.0%	100.0%
		% within Uric Acid	100.0%	100.0%	100.0%

p value 0.036

Among the study subjects 74% had SUA less than 6.5 mg/dl compared to 26% of the study subjects have elevated SUA (>6.5 mg/dl).It is evident from the study that 100% of patients with LDL (<100mg/dl) had there SUA < 6.5 compared to 0% of the patients with LDL (<100mg/dl) had elevated SUA .

In contrast 67.5% of the patients with LDL (>100mg/dl) had SUA <6.5 and 32.5% of the patient with LDL (100mg/dl) had SUA > 6.5. This difference was found to be statistically significant.

BAR DIAGRAM SHOWING CORRELATION BETWEEN LDL AND SUA

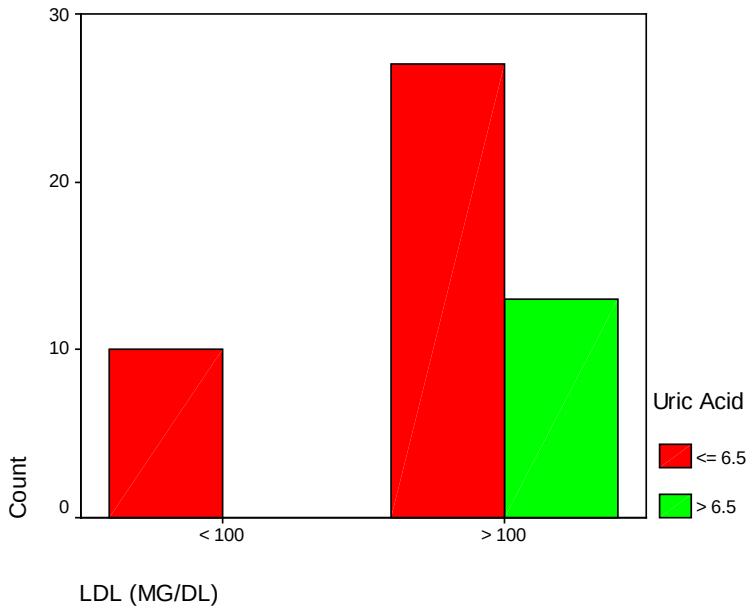


Table 23: CROSS TABULATION BETWEEN TGL AND SUA

			Uric Acid		
			<= 6.5	> 6.5	Total
TGL (MG/DL)	< 150	Count	34	11	45
		% within TGL (MG/DL)	75.6%	24.4%	100.0%
		% within Uric Acid	91.9%	84.6%	90.0%
	> 150	Count	3	2	5
		% within TGL (MG/DL)	60.0%	40.0%	100.0%
% within Uric Acid		8.1%	15.4%	10.0%	
Total		Count	37	13	50
		% within TGL (MG/DL)	74.0%	26.0%	100.0%
		% within Uric Acid	100.0%	100.0%	100.0%

p value 0.452

Among the study subjects 74% had SUA less than 6.5 mg/dl compared to 26% of the study subjects have elevated SUA (>6.5 mg/dl).It is evident from the study that 75.6% of patients with TGL (<150mg/dl) had there SUA < 6.5 compared to24.4% of the patients with TGL(<150mg/dl) had elevated SUA . In contrast 60% of the patients with TGL (>150mg/dl) had SUA <6.5 and 40% of the patient with TGL (>150mg/dl) had SUA > 6.5. This difference was found to be statistically in significant.

BAR DIAGRAM SHOWING CORRELATION BETWEEN TGL AND SUA

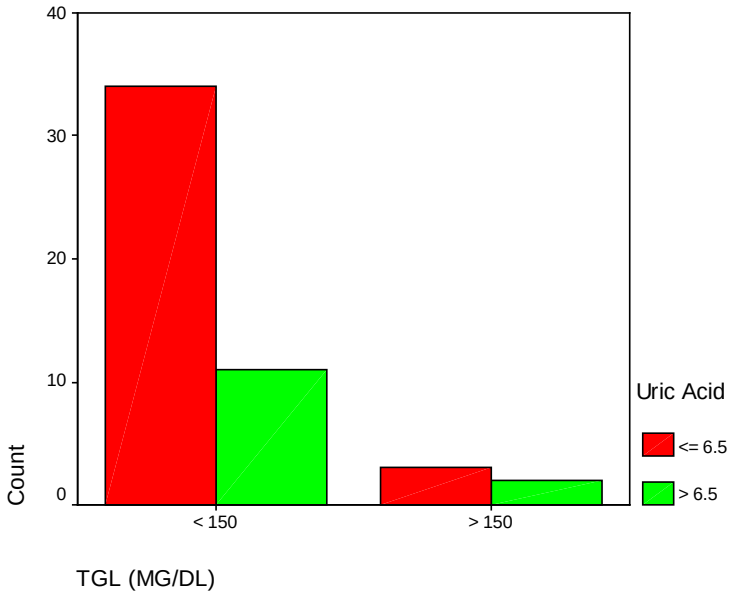


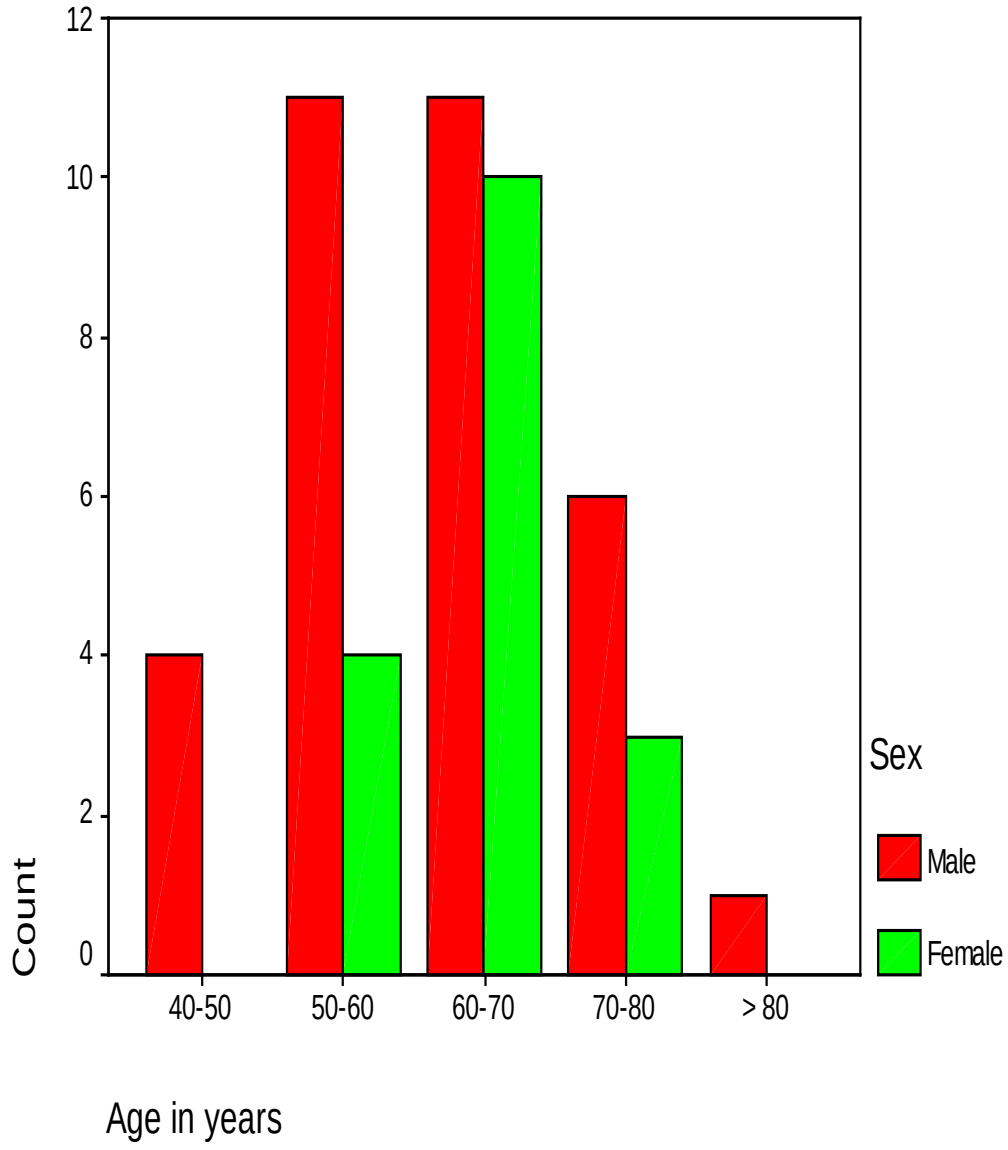
Table 24: CROSS TABULATION BETWEEN AGE AND SEX

			Sex		
			Male	Female	Total
Age in years	40-50	Count	4	0	4
		% within Age in years	100.0%	.0%	100.0%
		% within Sex	12.1%	.0%	8.0%
	50-60	Count	11	4	15
		% within Age in years	73.3%	26.7%	100.0%
		% within Sex	33.3%	23.5%	30.0%
	60-70	Count	11	10	21
		% within Age in years	52.4%	47.6%	100.0%
		% within Sex	33.3%	58.8%	42.0%
	70-80	Count	6	3	9
		% within Age in years	66.7%	33.3%	100.0%

		% within Sex	18.2%	17.6%	18.0%
	> 80	Count	1	0	1
		% within Age in years	100.0%	.0%	100.0%
% within Sex		3.0%	.0%	2.0%	
Total		Count	33	17	50
		% within Age in years	66.0%	34.0%	100.0%
		% within Sex	100.0%	100.0%	100.0%

p value – 0.34

BAR DIAGRAM SHOWING CORRELATION BETWEEN AGE AND SEX



DISCUSSION

This study, conducted at The Department of Internal Medicine, GOVT ROYAPETTAH HOSPITAL, and KILPAUK MEDICAL COLLEGE included the patients with acute ischemic stroke. Levels of serum uric acid were studied within 24 hours of admission. The SUA was taken after 4-6 hours of fasting. The mean value of SERUM URIC ACID (SUA) was taken as 6.5 mg / dl. The value was compared with various risk factors of the CVD.

About 50 patients participated in the study of which 33 (66%) were male and 17(34%) were female. In the study 38% of the patients were below 60 years and 62% of the patients were above 60 years. The study revealed that the correlation between the age and the level of uric acid was insignificant with p value >0.05

In the study about 48% of the study population had BMI <24.9 and 52% of the study population had a BMI>25. The study revealed the correlation between the BMI and uric acid as significant with p value <0.05

In the study about 38% of the study population were hypertensive and 62% were normotensive. The study revealed the association between the hypertension and uric acid as significant with p value <0.05

In the study about 36% of the study population were diabetic and 64% were non diabetic. The study revealed the association between the diabetes and uric acid as significant with p value <0.04

In the study about 30% of the study population were CAD patient and 70% were non CAD patients. The study revealed the association between the CAD and uric acid as significant with p value <0.029

In the study about 34% of the study population were smokers and 66% were non smokers . The study revealed the association between the smoking and uric acid as insignificant with p value <0.2

In the study about 26% of the study population were alcoholics and 74% were non alcoholic. The study revealed the association between the alcohol and uric acid as significant with p value <0.05.

In the study about 40% of the study population were vegetarian and 60% were non vegetarian . The study revealed the association between the diet and uric acid as significant with p value <0.035.

In the study about 76% of the study population were hemiparetic and 24% were hemiplegic. The study revealed the association between the hemiparesis and hemiplegia with elevated uric acid as significant with p value <0.05.

In the study about 86% of the study population have normal cholesterol and 14% have high cholesterol . The study revealed the association between the cholesterol and uric acid as significant with p value <0.05

In the study about 20% of the study population have normal LDL and 80% have high LDL. The study revealed the association between LDL and uric acid as significant with p value <0.05

In the study about 76% of the population have uric acid <6.5mg/dl and 24% of the population uric acid level > 6.5. This result reveals that serum uric acid was elevated in patients with acute ischemic stroke. This study also reveals that the association between uric acid with DM, CAD, SHT, alcohol, dyslipidemia is significant . The study also reveals that the association between SUA with smoking and age is insignificant. Serum uric acid, the strong anti oxidant, under certain circumstances like absence of other anti-oxidants may act as pro-oxidant. Thus serum uric acid may be taken as a marker of elevated risk of cerebrovascular accident.

The precise role of uric acid in vascular disease is to be studied and researched further.

CONCLUSION

1) This study shows that elevated SERUM URIC ACID is strongly associated with an increased risk for the development of acute ischemic/ non-embolic stroke in this study population.

2) SERUM URIC ACID is the substance with both anti inflammatory and pro-inflammatory activity

3) Elevated SUA can be considered as one of the risk factors for acute ischemic non-embolic stroke.

4) Elevated serum uric acid is found to be strongly associated with various risk factors of non-communicable disease

5) Lowering of SUA level can be considered as one of the preventive modalities for stroke while treating high risk population.

6) It is also suggested that further studies are required to assess whether lowering of SUA level with drugs can actually reduce the risk of ischemic stroke.

LIMITATIONS OF THE STUDY

- ✓ Short duration of the study
- ✓ Small sample size.

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PATIENT CONSENT FORM

STUDY DETAIL:

STUDY CENTRE:

PATIENT'S NAME:

PATIENT'S AGE:

IDENTIFICATION NUMBER:

I confirm that I have understood the purpose and procedure of the above study. I have the opportunity to ask questions and all my questions and doubts have been answered to my complete satisfaction.

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected.

I understand that the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However I understand that my identity would not be revealed, and any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study.

I hereby consent to participate in this study.

I hereby give permission to undergo complete clinical examination and diagnostic tests including haematological, biochemical, radiological tests.

Signature/thumb impression:

Patient’s name and address: Place:

Date:

Signature of the investigator:

Name of the investigator: Place:

Date:

PROFORMA

NAME:

AGE: SEX:

OCCUPATION:

ADDRESS:

EDUCATIONAL STATUS OF THE PATIENT:

PRESENTING COMPLAINTS:

DURATION OF PRESENTING COMPLAINTS:

Weakness of limbs :

Speech disturbance:

LOC;

Seizures:

Bladder and bowel disturbance:

Gait disturbance:

Imbalance and sway:

Vomiting:

Fever:

Headache:

Trauma:

Visual disturbances:

Chest pain:

Palpitations:

PAST HISTORY:

Diabetes Mellitus:

Hypertension:

Old history of CVA:

CAD:

RHD:

LVF:

CKD:

Gout:

Malignancies:

Thiazide intake:

H/o Urate renal stones:

PERSONAL HISTORY:

Alcohol:

Smoking:

Blood transfusions:

GENERAL EXAMINATION:

SYSTEMIC EXAMINATION:

CVS :

RS:

ABDOMEN:

CNS:

PARAMETERS MEASURED:

Weight of the patient.

BP:

PULSE:

LAB VALUES:

1. Serum Uric acid
2. Lipid profile
3. Fasting and PPBS in Diabetic patients
4. Renal function tests.
5. Electrolytes
6. CBC with Peripheral smear

S.No	NAME	Age in years	Age in years	Sex	BMI	BMI	SHT	DM	CAD	Smoking	Alcohol	Total Cholesterol (Mg/Dl)	Total Cholesterol (Mg/Dl)	LDL (MG/DL)	LDL (MG/DL)	TGL (MG/DL)	TGL (MG/DL)	Diet	Uric Acid	Uric Acid	Type of CVA
1	Kuppan	46	40-50	Male	24.0	20-24.9	No	No	No	Yes	No	198	< 200	148	> 100	110	< 150	Non-Vegeterian	3.4	<= 6.5	Hemiparesis
2	Sakunthala	64	60-70	Female	32.3	>= 30	No	Yes	No	No	No	210	> 200	152	> 100	148	< 150	Non-Vegeterian	7.4	> 6.5	Hemiplegia
3	Sekar	51	50-60	Male	21.5	20-24.9	Yes	Yes	Yes	Yes	Yes	188	< 200	130	> 100	123	< 150	Vegeterian	6.8	> 6.5	Hemiplegia
4	Kumarasamy	67	60-70	Male	30.0	>= 30	No	Yes	Yes	Yes	No	177	< 200	134	> 100	114	< 150	Non-Vegeterian	7.2	> 6.5	Hemiplegia
5	vinodhini	76	70-80	Female	29.6	25-29.9	Yes	No	No	No	Yes	210	> 200	125	> 100	157	> 150	Vegeterian	6.8	> 6.5	Hemiparesis
6	ramu	55	50-60	Male	32.0	>= 30	Yes	No	Yes	No	No	178	< 200	134	> 100	118	< 150	Non-Vegeterian	7.5	> 6.5	Hemiplegia
7	Babu	78	70-80	Male	27.9	25-29.9	No	Yes	No	Yes	Yes	231	> 200	102	> 100	109	< 150	Non-Vegeterian	7.2	> 6.5	Hemiplegia
8	Sasikala	67	60-70	Female	26.5	25-29.9	Yes	No	Yes	No	No	153	< 200	128	> 100	138	< 150	Vegeterian	5.1	<= 6.5	Hemiparesis
9	Manimegalai	80	70-80	Female	22.6	20-24.9	No	Yes	No	No	No	197	< 200	139	> 100	140	< 150	Non-Vegeterian	4.7	<= 6.5	Hemiparesis
10	Marimuthu	67	60-70	Male	25.5	25-29.9	No	No	No	Yes	Yes	175	< 200	98	< 100	118	< 150	Vegeterian	5.5	<= 6.5	Hemiparesis
11	Shagir hussain	79	70-80	Male	24.2	20-24.9	Yes	No	No	No	No	142	< 200	145	> 100	109	< 150	Vegeterian	4.9	<= 6.5	Hemiparesis
12	Ganga	64	60-70	Female	22.0	20-24.9	No	No	No	No	No	149	< 200	96	< 100	117	< 150	Vegeterian	5.2	<= 6.5	Hemiparesis
13	Sunbramanian	76	70-80	Male	24.0	20-24.9	No	No	No	No	No	198	< 200	146	> 100	167	> 150	Vegeterian	6.3	<= 6.5	Hemiparesis
14	Joseph	65	60-70	Male	26.2	25-29.9	No	No	No	Yes	No	187	< 200	143	> 100	157	> 150	Vegeterian	5.3	<= 6.5	Hemiparesis
15	Valli	67	60-70	Female	27.3	25-29.9	No	No	No	No	No	167	< 200	94	< 100	132	< 150	Vegeterian	2.1	<= 6.5	Hemiparesis
16	Kalaiarasi	55	50-60	Female	21.0	20-24.9	No	No	No	No	No	129	< 200	115	> 100	98	< 150	Vegeterian	3.4	<= 6.5	Hemiparesis
17	Elumalai	48	40-50	Male	29.6	25-29.9	No	No	No	Yes	No	188	< 200	167	> 100	156	> 150	Non-Vegeterian	6.2	<= 6.5	Hemiparesis
18	riaz ahmed	65	60-70	Male	28.5	25-29.9	No	No	No	No	No	202	< 200	96	< 100	117	< 150	Non-Vegeterian	6.3	<= 6.5	Hemiparesis
19	munniamal	59	50-60	Female	22.3	20-24.9	No	No	No	No	No	178	< 200	112	> 100	109	< 150	Non-Vegeterian	3.7	<= 6.5	Hemiparesis
20	Umayal	63	60-70	Female	23.0	20-24.9	No	No	No	No	No	165	< 200	134	> 100	111	< 150	Non-Vegeterian	4.5	<= 6.5	Hemiparesis
21	Ravi	78	70-80	Male	31.7	>= 30	Yes	Yes	Yes	Yes	Yes	199	< 200	156	> 100	165	> 150	Non-Vegeterian	7.9	> 6.5	Hemiplegia
22	Rajagopalan	55	50-60	Male	23.5	20-24.9	No	No	No	No	No	176	< 200	123	> 100	109	< 150	Vegeterian	4.3	<= 6.5	Hemiparesis
23	Vishnu	65	60-70	Male	22.7	20-24.9	No	Yes	Yes	Yes	No	167	< 200	89	< 100	97	< 150	Vegeterian	3.4	<= 6.5	Hemiparesis
24	Vikraman	56	50-60	Male	24.0	20-24.9	Yes	No	No	Yes	Yes	178	< 200	110	> 100	100	< 150	Non-Vegeterian	4.8	<= 6.5	Hemiparesis
25	Nandhagopalan	76	70-80	Male	21.5	20-24.9	No	No	No	No	No	154	< 200	132	> 100	112	< 150	Non-Vegeterian	3.9	<= 6.5	Hemiparesis
26	Abithambal	69	60-70	Female	22.0	20-24.9	No	No	No	No	No	143	< 200	94	< 100	102	< 150	Vegeterian	3.5	<= 6.5	Hemiparesis
27	Krishnan	56	50-60	Male	23.0	20-24.9	No	No	No	No	No	159	< 200	142	> 100	122	< 150	Vegeterian	4.6	<= 6.5	Hemiparesis
28	Jagadeesan	68	60-70	Male	32.0	>= 30	No	Yes	No	Yes	Yes	210	> 200	159	> 100	130	< 150	Non-Vegeterian	7.6	> 6.5	Hemiplegia
29	Devaiyani	67	60-70	Female	29.4	25-29.9	No	Yes	No	No	No	186	< 200	142	> 100	110	< 150	Non-Vegeterian	5.8	<= 6.5	Hemiparesis
30	Sadhanandhan	67	60-70	Male	28.6	25-29.9	Yes	Yes	No	No	No	176	< 200	152	> 100	106	< 150	Non-Vegeterian	7	> 6.5	Hemiplegia
31	Vasantha	64	60-70	Female	27.6	25-29.9	Yes	No	No	No	No	164	< 200	148	> 100	117	< 150	Vegeterian	5.6	<= 6.5	Hemiparesis
32	Kannadasan	43	40-50	Male	23.1	20-24.9	Yes	Yes	No	No	No	210	> 200	88	< 100	121	< 150	Non-Vegeterian	4.7	<= 6.5	Hemiparesis
33	Sherly	56	50-60	Female	26.3	25-29.9	No	No	No	No	No	156	< 200	92	< 100	100	< 150	Non-Vegeterian	5.3	<= 6.5	Hemiparesis
34	Nizam basha	50	40-50	Male	31.4	>= 30	Yes	No	Yes	No	Yes	208	> 200	114	> 100	102	< 150	Non-Vegeterian	7.9	> 6.5	Hemiplegia
35	Yasodha	67	60-70	Female	30.7	>= 30	Yes	Yes	Yes	No	No	154	< 200	122	> 100	104	< 150	Non-Vegeterian	7.6	> 6.5	Hemiplegia
36	Gopalakrishnan	55	50-60	Male	25.3	25-29.9	Yes	No	Yes	No	No	166	< 200	134	> 100	98	< 150	Vegeterian	5.7	<= 6.5	Hemiparesis
37	Madhavan	82	> 80	Male	21.0	20-24.9	Yes	Yes	Yes	Yes	Yes	156	< 200	96	< 100	104	< 150	Non-Vegeterian	4.2	<= 6.5	Hemiparesis
38	Gunasekaran	68	60-70	Male	23.0	20-24.9	No	No	No	No	No	146	< 200	90	< 100	100	< 150	Vegeterian	5.3	<= 6.5	Hemiparesis
39	Ganesan	79	70-80	Male	26.2	25-29.9	Yes	No	No	No	No	134	< 200	114	> 100	88	< 150	Non-Vegeterian	5.5	<= 6.5	Hemiparesis
40	Murali	54	50-60	Male	26.4	25-29.9	Yes	No	No	Yes	No	145	< 200	130	> 100	100	< 150	Vegeterian	6.5	<= 6.5	Hemiparesis

S.No	NAME	Age in years	Age in years	Sex	BMI	BMI	SHT	DM	CAD	Smoking	Alcohol	Total Cholesterol (Mg/Dl)	Total Cholesterol (Mg/Dl)	LDL (MG/DL)	LDL (MG/DL)	TGL (MG/DL)	TGL (MG/DL)	Diet	Uric Acid	Uric Acid	Type of CVA
41	Fathima	62	60-70	Female	28.6	25-29.9	No	No	Yes	No	Yes	214	> 200	121	> 100	96	< 150	Non-Vegeterian	7.4	> 6.5	Hemiplegia
42	Daniel	57	50-60	Male	27.4	25-29.9	No	Yes	No	No	No	144	< 200	118	> 100	102	< 150	Non-Vegeterian	6.2	<= 6.5	Hemiparesis
43	Selvaraghavan	58	50-60	Male	24.6	20-24.9	No	Yes	Yes	Yes	No	146	< 200	116	> 100	98	< 150	Vegeterian	5.3	<= 6.5	Hemiparesis
44	Kannan	60	50-60	Male	23.8	20-24.9	Yes	Yes	Yes	Yes	Yes	152	< 200	126	> 100	112	< 150	Non-Vegeterian	4.8	<= 6.5	Hemiparesis
45	Raseedha	59	50-60	Female	23.0	20-24.9	No	Yes	Yes	No	No	148	< 200	132	> 100	106	< 150	Non-Vegeterian	4.6	<= 6.5	Hemiparesis
46	kalyanaraman	67	60-70	Male	25.4	25-29.9	No	No	No	No	No	142	< 200	122	> 100	108	< 150	Non-Vegeterian	5.3	<= 6.5	Hemiparesis
47	Ahmed	69	60-70	Male	29.6	25-29.9	Yes	Yes	No	Yes	No	164	< 200	114	> 100	104	< 150	Non-Vegeterian	7.6	> 6.5	Hemiplegia
48	Neduncheralathan	56	50-60	Male	23.0	20-24.9	No	No	No	No	No	154	< 200	124	> 100	114	< 150	Non-Vegeterian	4.8	<= 6.5	Hemiparesis
49	Lakshmi	72	70-80	Female	22.0	20-24.9	No	No	No	No	No	148	< 200	114	> 100	102	< 150	Vegeterian	5.2	<= 6.5	Hemiparesis
50	Sankar	65	60-70	Male	23.6	20-24.9	Yes	No	Yes	Yes	Yes	134	< 200	112	> 100	108	< 150	Non-Vegeterian	4.6	<= 6.5	Hemiparesis