"A STUDY ON THE ROLE OF SERUM CALCIUM, SERUM ALBUMIN AND SERUM URIC ACID AS MARKERS OF INITIAL NEUROLOGICAL SEVERITY AND SHORT TERM OUTCOME INDICATORS IN ACUTE ISCHEMIC STROKE"

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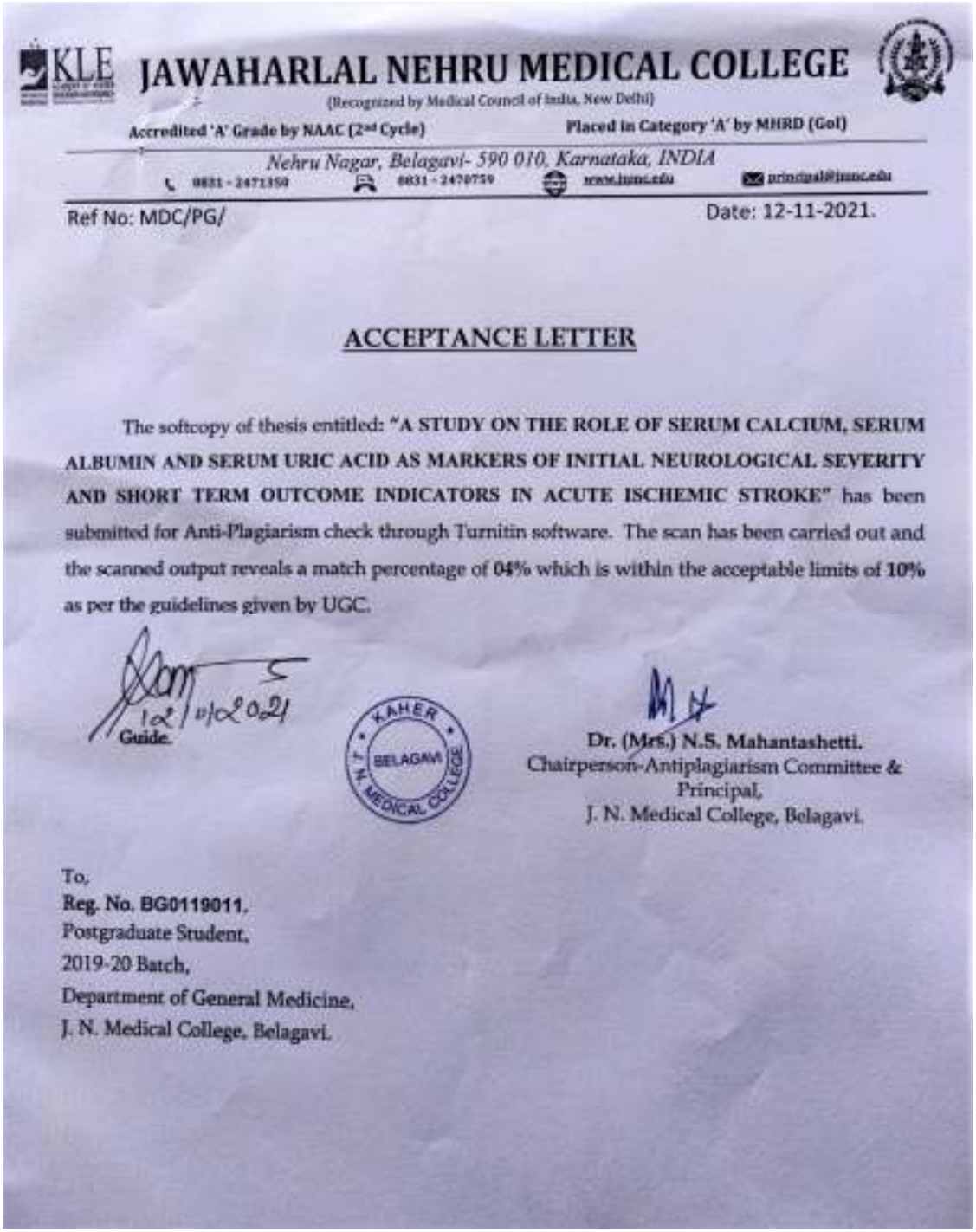

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LIST OF ABBREVIATIONS

GLOSSARY	ABBREVIATIONS
GBD	Global Burden of Disease
DALY	Disability Adjusted Life Years
CSF	Cerebrospinal Fluid
CT	Computerized Tomography
MRI	Magnetic Resonance Imaging
SAH	Subarachnoid Hemorrhage
TIA	Transient Ischemic Attack
BMI	Body Mass Index
CVA	Cerebro Vascular Accident
IHD	Ischemic Heart Disease
DM	Diabetes Mellitus
PAN	Polyarteritis Nodosa
APLA	Anti-Phospholipid Antibody Syndrome
tPA	Tissue Plasminogen Activator
ACA	Anterior Cerebral Artery
MCA	Middle Cerebral Artery
PCA	Posterior Cerebral Artery
NIHSS	National Institute of Health Stroke Scale
MRS	Modified Rankin Scale
SSS	Scandinavian Stroke Scale
GCS	Glasgow Coma Scale
GRE	Gradient Recalled ECHO
NMDA	N-Methyl D-Aspartate
mRECT	Modified Repinotan Randomized Exposure Controlled Trial

ABSTRACT

TITLE: "A STUDY ON THE ROLE OF SERUM CALCIUM, SERUM ALBUMIN AND SERUM URIC ACID AS MARKERS OF INITIAL NEUROLOGICAL SEVERITY AND SHORT TERM OUTCOME INDICATORS IN ACUTE ISCHEMIC STROKE"

BACKGROUND AND OBJECTIVES: Stroke is defined as 'the rapid development of clinical signs and symptoms of a focal neurological deficit lasting for more than 24 hours or leading to death with no apparent cause other than vascular origin'. The diagnosis of ischemic stroke is mainly clinical, with identification of vascular territory involved by CT/MRI Brain. Certain biochemical parameters homeostasis changes with this acute event, giving information regarding the severity and prognosis of Stroke. Serum Calcium has an important role in signal transduction pathways and may influence the severity of stroke during initial period. Serum Albumin is an acute phase reactant having neuro-protective properties and an indicator of nutritional status. Thus the incidence and recovery from an ischemic stroke is prejudiced by serum albumin. Serum Uric Acid acts as a marker of tissue infarction. Its levels increase with increase in neuron death; indicating poor prognosis of ischemic stroke. There are numerous research conducted to study the influence of either Serum Calcium or Serum Albumin or Serum Uric Acid on Acute Ischemic stroke; but taking all the three parameters at once to analyse is a rarity. This study was conducted using all the three lab parameters and clinical assessment to improve our understanding of the same.

MATERIALS AND METHODS: This is a one year Observational Cross sectional study conducted on 65 patients aged above 18 years, presenting with Acute Ischemic

Stroke within 24 hours of onset; admitted at KLE's Dr Prabhakar Kore Hospital & MRC, Belagavi.

CT/MRI Brain was done before admission to confirm acute ischemic stroke. Patients with Haemorrhagic stroke, chronic liver & renal diseases were excluded. National Institute of Health Stroke Scale (NIHSS) severity score was calculated at admission, along with estimation of Serum Calcium, Albumin & Uric acid. Short term prognosis is assessed based on functional improvement using Modified Rankin Scale (MRS) grading done at the end of 1st week.

RESULTS: In our present study of 65 patients various demographic factors, comorbidities, habits, clinical presentation with signs, lab parameters and neuroimaging were compared with National Institute of Health Stroke Scale severity score and lab parameters alone with Modified Rankin Scale grading.

Stroke was common in the age group of 5th to 8th decade. Male patients were 45 (69.23%) and female patients were 20 (30.77%). Male preponderance was seen with the ratio of 2.25:1. Hypertension was seen in 17 patients (26.15%), overlapping comorbidities were observed in 19 patients (29.23%), Diabetes in 06 patients (9.23%), Coronary artery disease in 05 (7.69%) and no comorbidities in 18 patients (27.69%). Hypertension and Diabetes did not show any significant correlation on outcome in our present study. Lab parameters like serum calcium, serum albumin and serum uric acid when compared with NIHSS scoring; the positive correlation was seen only with low serum calcium levels. Other two parameters (serum albumin and uric acid) did not show any positive correlation with National Institute of Health Stroke Scale severity. Similarly comparing all the three parameters with Modified Rankin Scale did not show any positive correlation.

CONCLUSION: We observed a significant correlation only between serum calcium levels (low levels) and NIHSS severity scale. However there was no association between NIHSS and serum albumin, serum uric acid levels or any other demographic factors. The three lab parameters did not yield any association with MRS grades. There is a need to conduct a large scale prospective study and to consider various other patient related factors to eliminate bias and to establish association between those three lab parameters with acute ischemic stroke.

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INTRODUCTION

A Cerebrovascular accident or Stroke is a syndrome occurring due to a local vascular etiology consisting of sudden death or a neurological deficit. This description about stroke is defined based on clinical assessment, further which is confirmed using various neuro imaging. Stroke will emerge as a significant burden to society in upcoming years irrespective of the developmental status of the country.[1]

Serum Calcium plays a pivotal role in signal transduction pathways and as a cofactor of many enzymes. Cell calcium metabolism during and immediately after a transient period of ischemia, influences the cascade of events in cerebral injury. It shows a link between serum calcium and stroke prognosis. This association of serum calcium and stroke has to be further studied in detail to analyze calcium as a prognostic marker.[2]

Serum Albumin is the most abundant plasma protein in humans. It gives information regarding a person's nutritional status. Poor health status leads to varied disease occurrence; stroke is also one among them. Protein energy malnutrition is associated with stroke and it has a poor outcome. Even though stroke has a multifactorial etiology; albumin deficiency is one of the important predictors for pitiable functional deficits. One essential function of albumin is to carry anti thrombin and heparin cofactor, which contribute to the anticlotting property of albumin. This increases blood flow to the ischemic brain tissue.[3]

Serum Uric Acid is the ultimate metabolic product of purine. It is present as sodium urate in extracellular compartment and cleared from plasma by the kidneys. The most important feature of uric acid is its anti-oxidant and free radicals scavenging property. Increased level of uric acid is associated with gout, cardiovascular disease,

insulin resistance and metabolic syndrome. The beneficial effects of either higher levels or lower levels of uric acid are still controversial. This inconsistency about uric acid might be because of trial methods, race, location and culture of the study population, sex or social and economic influence. But it definitely warrants to be studied in detail.[4]

Acute Ischemic Stroke severity, prognosis and functional outcome depend on multiple factors. One of the important factors among them is the infarct size. Patient's general health condition and volume of the infarct constitute the key elements in recovery of the patient.[5]

NECESSITY OF THIS STUDY:

The incidence of stroke, either ischemic or hemorrhagic is increasing rapidly in India. This shows the deterioration of health in recent generation. To assess the severity, prognosis and outcome of this common debilitating disease we require simple techniques along with neuroimaging. Clinical assessment, estimation of simple lab parameters like serum calcium, albumin and uric acid may fill that void of 'simple parameters in measuring the functional outcome of stroke.'

The most important goal is to prevent the occurrence of stroke by detecting and avoiding the predisposing factors and also in promoting public awareness regarding it. There are numerous authors who have studied the correlation of single parameter (Serum Calcium or serum Albumin or Serum Uric acid) with acute ischemic stroke, giving different opinions and results. But very few studies have taken all the 3 parameters into consideration at a time.

So this study has been undertaken with the forethought that if the association of all the three lab parameters with stroke can be proven beyond doubt, it may be helpful to predict and institute remedial methods to improve the prognosis of this disease.

OBJECTIVE OF THE STUDY

To Study the role of Serum Albumin, Serum Calcium Serum Uric acid as markers of initial neurologic severity and indicators of short-term functional outcome in patients with Acute Ischemic Stroke.

REVIEW OF LITERATURE

AFFLICTION OF STROKE:

Stroke or CVA has risen to the 2nd place in the table of 'total deaths in the world due to a systemic disease', with sum total approaching 6.2 million people in 2015 and an increase of 0.83 million from the year 2000. The incidence of stroke is rising worldwide with more cases being seen in the population which is having less access to the medical facility like underdeveloped and developing countries, while it is decreasing among the developed nations solely due to an established and timely medical care.[6]

According to the results of 'Global Burden of Disease' (GBD) study that was published in 2019, the incidence of stroke was 12.2 million cases, prevalence was 101 million, and fatalities were 6.55 million. Stroke related Disability Adjusted Life Years was 143 million. Majority of this pattern of statistics of GBD were seen in low to middle income countries. In high income countries due to improved knowledge about health, death incidence reduced and patients survived with residual disability; increasing the DALY index.[7]

The latest statistics of stroke in India shows the 'crude incidence' ranged from 108 to 172/100,000 people per year, 'crude prevalence' from 26 to 757/100,000 people per year, and 'one-month case fatality rates' from 18% to 42%.[8] The GBD study of 2019, quoted 'stroke is the single largest entity among all the neurological disorder DALY's in India (37·9%).[9]

CLASSIFICATION OF CVA:

Based on the findings of CT, MRI, MRI Angiography of brain vessels or autopsy, stroke can be classified into four types:

A. Ischemic stroke

B. Primary Intra-cerebral Hemorrhage

C. Subarachnoid Hemorrhage – additionally can also be diagnosed by Cerebrospinal fluid (CSF) analysis

D. Undetermined stroke (no above mentioned investigations reveal the etiology).[10]

The type of stroke that occurs due to reduction in the blood supply to brain is known as the Ischemic Stroke. The second one occurs due to a vascular rupture leading to hemorrhage in the brain parenchyma, known as the Hemorrhagic Stroke. The involved area of brain does not function properly producing the clinical features of loss of power and sensations of one half of the body or face, speech and sensorium alterations or giddiness. Headache may also be associated. The size and location of the infarct depends on collateral circulation.[11]

Subarachnoid hemorrhage (SAH) occurs spontaneously, contributing 2 - 7% of all stroke cases. 85% of cases among SAH are caused by rupture of berry aneurysm (one of the most common form of intracranial aneurysm) due to raise in blood pressure.[12]

In cases of TIA; clinical features of stroke stay for a transient period of less than 24 hours and patient becomes free of those symptoms after that period. Radiological investigations do not show any anatomical changes in cases of TIA. It acts as a precursor and predictor to an impending Ischemic stroke.[13]

STROKE – THE COMORBID CONDITIONS AND HABITS:

Decades of study regarding the comorbidities in stroke has finally been categorized as modifiable and non-modifiable risk factors.[14] Age, gender, race, cultural background and inheritance characters are considered as non-modifiable. Wherein the modifiable comorbidities for ischemic stroke include hypertension, heart diseases, long standing diabetes mellitus, increased BMI and deranged lipid profile.

Some habits also contribute to the occurrence of stroke; like chronic alcohol consumption, illicit abuse of drugs, consumption of tobacco in the form of gutka or cigarettes, lack of physical activities and unhealthy diet.[15]

{i} Sex and Age as risk factors:-

According to a study conducted by El Tallawy HN et al; males had more prevalence of stroke due to the risk factors like smoking, stress and hormonal influence compared to females.[16] Also many authors have stated regarding the incidence of stroke being higher in population as age increases; because age acts as a snowballing agent on other stroke risk factors and also reducing the functionality of cardiovascular system over a period of time.[17,18]

{ii} Hypertension and Blood pressure:-

This is the most common risk factor to cause both ischemic and hemorrhagic stroke.[19] One of the study conducted on primary prevention of stroke states that; there is 33% reduction in incidence risk with each 10 mmHg decrease in blood pressure.[20] There is ischemia to periventricular white matter from hypo-perfusion, due to remodeling of cortical blood vessels caused by the effect of prolong raised BP. Specifically these areas are located between two arterial territories.[21]

{iii} Effects of Diabetes mellitus:-

DM has two important pathogenic mechanisms; first one being elevation in insulin and clotting factor levels which act as building blocks for micro-angiopathic stroke. Second one being accelerated atherosclerotic process, destructing macro vessels leading to a large artery stroke.[22]

{iv} Lipid profile alterations:-

The mediators of lipid metabolism are very vital for normal functioning of brain tissue and its anatomy. The breakdown of polyunsaturated fatty acids has a role in post stroke alteration also. It might have degenerative effects or protective effects on the brain.[23]

{v} Cardiac disease and stroke:-

Presence of heart disease hampers the recovery of a stroke patient by inhibiting patient participation in rehabilitation and physiotherapy. The functional outcome is directly affected leading to premature death of a CVA patient. Atrial fibrillation in an IHD patient is the immediate precursor to embolic stroke.[24]

{vi} Tobacco consumption:-

Using tobacco in any form is most hazardous in triggering stroke. It depends on the amount of smoking also; with chain smokers having highest risk and intermittent smokers having lesser risk. Cessation of tobacco keeps smokers at the same level of non-smokers by the end of five years. Additionally chewing tobacco acts as a direct etiology for cerebral venous thrombosis.[25]

{vii} Alcohol effects on stroke:-

There are enough studies done regarding the association of stroke and alcohol consumption. Different opinions have been sought; but one of the meta-analysis studies got to the conclusion that taking alcohol in limited amounts (< 60ml/day) reduces the risk of ischemic stroke and heavier amounts (>60ml/day) leading to occurrence of hemorrhagic stroke. Although it is depending on individual level of alcohol metabolism, there can be a significant association of alcoholism with stroke compared to non -alcoholics.[26,27]

{viii} Life Style:-

Lack of physical activity in recent world has driven people into the verge of clinical syndromes. Not just stroke, but the risk of all cardiovascular diseases has increased. The incidence of other diseases namely obesity, depression, renal diseases, growth retardation and cancer have increased drastically. Life expectancy is also on the downtrend.

PATHOGENIC MECHANISMS IN STROKE:

The pathogenesis involved in thrombosis begins with the destruction of vessel wall endothelium by any of the etiological agent. There is activation of platelets and inflammatory mediators. This causes a local inflammation associated with the increase in platelet adherence and activation of coagulation cascade. Result of this is the narrowing of blood vessels due to deposition of fatty plaques superadded with calcium and fibrin as a consequence of atherosclerosis. This marks the decline in blood flow. The construct of plaque will ultimately shrink the vascular chamber and produce clots, initiating thrombotic stroke.[28]

This kind of similar pathogenesis is also seen in an embolic stroke, but here occlusion occurs due to a clot breaking from the thrombus and blocking one of the major arteries of the brain. Some sources of emboli include –

- Most common embolic event leading to cerebral infarction is by atrial fibrillation
- Valvular thrombi (cardiac prosthetic valves)
- Mural thrombi
- Atrial myxoma
- Multiple small emboli can be seen in inflammatory cases.
- Rare causes include hypercoagulable conditions like Protein C and S deficiency, APLA, homocysteinemia and venous sinus thrombosis.
- Rheumatological causes – Takayasu arteritis, PAN, Wegener's granulomatosis etc.

Any of the above finally leads to an unadorned trauma and ill-timed cell death, known as necrosis. There is plasma membrane commotion subsequent to the necrosis, organelle bulging and seeping of cellular substances into the extracellular area and functional loss of neurons.[29]

Some vital events backing the stroke pathology comprise infiltration of leukocytes, weakening of the blood–brain barrier, energy catastrophe, loss of homeostasis, inflammatory reaction, acidosis, elevated intracellular calcium, excito-noxiousness, free radical-mediated harmfulness, cytokine-reconciled cytotoxicity, complement system triggering, oxidative stress and stimulation of glial cells.[30–34]

The immediate ischemic cascade – failure of sodium-potassium ATPase ensues. Then there is retention of sodium with cytotoxic edema and influx of calcium in exchange for sodium. Excitatory neurotransmitters are released due to calcium influx like glutamate, finally destroying the integrity and structure of neurons.[35]

In Ischemic Stroke, the tissue-type plasminogen activator (tPA) breaks the tissue plasminogen to plasmin (an endogenous powerful fibrinolytic agent) so that it gets deposited over the formed thrombus. Intravenous recombinant tPA (for example - alteplase) dissolves this thrombus and provides a good functional outcome in patients presenting within 4 hours 30 minutes of symptom onset. Thus showing it as immensely depending on time, but not depending on the severity of stroke or age of the patient.[36]

The mechanism behind hemorrhagic transformation of ischemic stroke includes reperfusion of the injured tissue via collateral circulation or via recanalization of the obstructed vessel. Rarely there might be rupture of weakened capillaries or blood brain barrier.

SITES OF INFARCTION:

1) Large Vessel strokes:

Involves carotid arteries, ACA, MCA, PCA and the vertebral arteries. Some common sites of thrombus occlusion are bifurcation of common carotid artery, MCA at and just before its trifurcation, origin of vertebral artery. Here there will be infarction of a single large territory. Sometimes there might be a shower of emboli breaking from a large thrombus and getting lodged in smaller branches of these vessels.[37]

2) Small Vessel strokes:

Also knows as Lacunar Infarcts. Pathology comprises lipohyalinosis, small atheroma formation and fibrinoid necrosis. The microcirculation will be involved leading to infarcts in common areas of brain like corona radiata, internal capsule, pons and thalamus. Theses lacunar infarcts produce characteristic clinical signs depending on the area involved; some examples are – clumsy hand syndrome, hemiballism, hemi-chorea, slurred speech, ataxic hemiparesis, mixed sensorimotor or pure sensory to pure motor.[38]

3) Watershed infarcts:

This is the intermediate area between the two major arteries. Infarct occurs here mostly because of hypo perfusion or chronic hypotension.

ASSESSMENT SCALES USED IN STROKE:

The best predictor in assessing severity of stroke is the clinical examination. A complete and accurate neurological examination should be done in emergency room itself. Stroke should be differentiated from stroke mimics like

a) Seizure

b) CNS tumors

c) Metabolic encephalopathy

d) Severe positional vertigo or

e) Any psychiatric illness like conversion disorder.

Apart from neurological examination, a baseline stroke deficit at presentation should be assessed. This gives us an idea about the severity of stroke and its prognosis. Also helps us in planning the treatment modality. Lot of severity scales have been designed worldwide. Some commonly used scales for initial assessment include National Institutes of Health Stroke Scale (NIHSS), Scandinavian Stroke scale (SSS) or Glasgow Coma Scale (GCS). They act as one of the strong predictors of outcome. Earlier the improvement in baseline deficits, better will be the outcome.[39]

The most widely used initial neurological deficit scale in the world is NIHSS. In patient evaluation, drawing tables in clinical trials for prevention, treatment and recovery needs a simple tool. That is where NIHSS acts as a gold standard assessor. It can be used at different times of patient recovery too, for example at discharge or at 3 months.[40]

NIHSS is a scale of 42 points that is divided into 6 main areas of the neurological examination - consciousness level, pictorial examination, motor system examination, sensory system, cerebellum and speech or articulation. Biggest advantage of this scale is its simplicity. As the points increase prognosis declines with zero being 'no stroke' to 42 being 'the worst possible disability in stroke or coma'.[41]

Table 1: National Institute Of Health Stroke Scale (Nihss)

INSTRUCTION/TEST DONE	DEFINITION OF SCORE	SCORES AT ADMISSION
1a.. Loss Of Consciousness	0 – '**Alert' and** response is keen 1 – '**Not Alert',** but can be aroused by minor stimulation to follow & respond 2 – '**Not Alert'**; requires repeat stimulation, 'obtunded', requires strong stimuli 3 – totally unresponsive, flaccid	
1b.. LOC Question Ask the patient the month & age	0 - '**Answers both** questions' correctly 1 – '**Answers one** question' correctly 2 – '**Doesn't Answer both** questions' correctly	
1c.. LOC Commands 1st -Ask to open & close eyes, 2nd – to hold grip & release using his non-paretic hand.	0 – '**Performs both** tasks' correctly 1 – '**Performs one** task' correctly 2 – '**Doesn't Perform both** task' correctly	
2.. Gaze Ask to follow the object using his eyes along horizontal plane (or oculo cephalic maneuver).	0 - **Normal** 1 – '**Partial Gaze Palsy'** - gaze is abnormal in one or both the eyes. Forced deviation or total gaze paresis is absent. 2 - '**Forced deviation' -** total gaze paresis; not overcome by oculo cephalic maneuver	
3.. Visual field Testing done by finger counting method or by confrontation method.	0 - '**No'** visual loss 1 - '**Partial'** hemianopia 2 – '**Complete'** hemianopia 3 - '**Bilateral'** hemianopia (including cortical blindness).	
4.. Facial Palsy Asked to show teeth & raise eyebrows	0 – '**Normal'** symmetrical movement 1 – '**Minor paralysis'** (flattened naso-labial fold, asymmetry on smiling) 2 - '**Partial paralysis'** (total or near total	

	paralysis of lower face) 3 – '**Complete paralysis'** of one or both sides (no upper & lower face movement).	
5.. <u>Motor Arm</u> With palm facing down patient is asked to extend arms by 90º (if sitting) or by 45º (supine) & hold it for 10 seconds. Procedure should begin with non-paretic limb.	0 – '**No drift'** – holds limb for full 10 seconds 1 – '**Drift' -** holds limb at 90º(or 45º); and drifts down before full 10 seconds but does not hit bed or other support 2 – '**Some effort against gravity**' - limb cannot get to or maintain (if cued 90ºor 45º). They drift down to bed, but has some effort against gravity 3 – '**No effort against gravity**' limb falls 4 - **No movement** *UN – Explain if Joint fusion or Amputation	**Left Arm:** **Right Arm:**
6.. <u>Motor Leg</u> Patient is asked to hold the leg at 30º for 5 seconds in supine position.	0 – '**No drift**'- Hold leg for full 5 seconds 1 – '**Drift**' – Leg falls but doesn't hit bed. 2 – '**Some effort against gravity**' – leg falls to bed within 5 sec 3 – '**No effort against gravity**' - leg falls immediately to bed when raised. 4 – '**No movement'** *UN - Explain if Joint fusion or Amputation	**Left Leg:** **Right Leg:**
7..<u>Limb Ataxia</u> Tested by Finger – nose method & heel – shin method on both the sides	0 – '**Absent'** 1 – '**Present in one** limb' 2 – '**Present in both** limbs' *UN - Explain if Joint fusion or Amputation	
8.. <u>Sensory</u> Sensation or grimace to pin prick or withdrawal from noxious stimuli to limbs in obtunded or aphasic patient.	0 – '**Normal**' - no sensory loss 1 – '**Mild or Moderate'** sensory loss - may not be as sharp (dulled). 2 – '**Severe or Total'** sensory loss - Unaware of touch on leg/arm/face	
9.. <u>Best Language</u> Instruct the patient to describe what is going on in picture. Name few items or figures. Read list of sentences on attached figures.	0 – '**No aphasia'** normal 1 – '**Mild or moderate aphasia**' some loss of fluency / comprehension, without limitation of expression of ideas. (but can identify what is happening in picture) 2 – '**Severe aphasia**' - cannot identify pictures 3 – '**Mute**' - global aphasia; no usable speech or auditory comprehension.	

10..Dysarthria Instruct patient to read or repeat the words from list given.	0 – '**Normal**' articulation 1 – '**Mild or Moderate**' slurring of some words; can understand with some difficulty 2 – '**Severe**' so slurred as to be unintelligible; Anarthric and mute. *UN - Intubated	
11..Extinction & Inattention Look at visual and simultaneous double tactile stimulus. Do in both arms & legs.	0 – '**No'** abnormality 1 – '**Visual, tactile, auditory, spatial or personal inattention** or extinction to bilateral stimulation in one sensory modalities. 2 – '**Profound hemi-inattention'** or inattention to more than one modality; does not recognize own hand; orients to only one side of space.	

NIHSS Scores and stroke severity:-

Score 0 – No stroke

Score 1-4 – Mild stroke

Score 5-15 – Moderate stroke

Score 16 – 20 – Severe stroke

The smaller version of NIHSS is called 'Modified National Institute of Stroke Scale' (mNIHSS). It is a validated and easier version mainly used in assessing the risk of bleeding during tPA treatment. Medical records alone are enough to calculate this score without clinical reassessment.[42]

The activities of daily living post stroke are assessed by modified Rankin Scale (mRS). The degree of disability or dependence of people who have suffered a stroke and their prognosis are studied by using this scale. It has become the most widely used clinical outcome measure for clinical trials of stroke.[43] Around 2005 to 2008 the MRS was made into a scale consisting of 6 scores, after its introduction in the year 1957. '0' indicates no symptoms and '6' indicates death.[44]

Table 2: Modified Rankin Scale (Mrs)

SCORES	DESCRIPTION
0	No symptoms at all
Score 1	No significant disability present despite symptoms; And able to carry out all usual duties and activities
Score 2	Slight disability present; unable to carry out all previously done activities, but able to look after once own affairs without any assistance
Score 3	Moderate disability present, that warrants some help. But able to walk without any assistance
Score 4	Moderately severe disability; unable to walk without assistance. To attend to once own bodily needs requires assistance.
Score 5	Severe disability; Is incontinent and bedridden, requires constant nursing care and attention.
Score 6	Death

Neuroimaging in Stroke:

The 2nd face in diagnosis of stroke is neuroimaging. Without neuroimaging stroke cannot be visualized in recent era. The two main modalities include CT brain and MRI brain. CT Brain is the initial investigation of choice in diagnosing stroke as it is most helpful in initial 6 – 8 hours of symptom onset. It helps in differentiating infarct from hemorrhage. CT brain can be done with or without contrast and also with angiography to locate the exact site of vessel occlusion. Similarly MRI brain helps in identifying stroke; but it is more useful during sub-acute or chronic phase and follow up. Different techniques are there in MRI to further visualize areas of small infarctions and small vessel blockades; include MR perfusion studies, MR Diffusion, GRE (Gradient recalled echo) and MR Angiography.[45]

Serum Calcium:

The Ca2+ ion (calcium) is an abundant intracellular envoy during and instantly after an episode of ischemia, and it impacts torrent of happenings that lead to successive neuronal injury.[46] During such circumstances, discharge of glutamate from the nerve and glial cells actuates the NMDA receptor (N-methyl-D-aspartate) and prompts the hasty translocation of Calcium ion from extra-cellular to intra-cellular spaces in cerebral tissues. Removing calcium from extracellular medium or preventing it from entering mitochondria by uncouplers, protects neurons from excite-toxic injury of glutamate. Mitochondria filled with calcium ions activates calpains, caspases, kinases, endonucleases, and other proteases causing apoptosis and also acts as a source of free radicals after reperfusion.[47,48]

The studies are conducted to know both the beneficial effects and harmful effects of serum calcium in cases of stroke especially acute ischemic stroke.[49,50] In distinction to a formerly thought belief, latest studies advocate that raised calcium levels within one day of stroke commencement are linked with smaller infarction dimensions and healthier clinical outcomes after getting discharge from hospital. Majority of calcium is bound to albumin in serum, with minimal amount of unbound or free calcium. This unbound calcium is the one that exerts all the functions. Hence the level of serum calcium is depending on the concentration of serum albumin.[51,52]

Normal range of total serum calcium is 8.6 to 10.2 mg/dl. Normal value of ionized or free calcium is 4.5 – 4.9 mg/dl.[53]

Formula for corrected calcium (in mg/dl)

0.8 (normal albumin level – patient's albumin level) + serum calcium level

Each 1 g/dl reduction in serum albumin will reduce total calcium concentration by approximately 0.8 mg/dl without altering free calcium levels.[53]

There is a split view regarding the outcome as well as mortality at both extremes of calcium values and illustrious ideal long-term survival for a diverse array of serum calcium levels.[54]

Serum Albumin:

Serum albumin is the most abundant protein in serum and a multi purposeful protein that also bids neuro protective effects. It binds most of the important components required for normal cellular function.[55] Experimental studies on animals have shown that albumin is a promising neuron defending agent either focally or in globally affected cerebral ischemia. It acts as the neuroprotectant even in traumatic brain injury.[56]

The levels of albumin in serum have been accredited to abide as indicator of nutritional status.[57] For immediate assessment of nutritional status in stroke albumin is taken into account; at admission as a reference point and within 24 hours of stroke onset. It is already known that it may not be affected by the acute stress reaction after stroke. Hypo-albuminaemia at baseline may be allied with premorbid nutritional condition, negative effect on outcome and poor prognosis that is further attributable to a longer half-life of albumin.[58]

Many research articles published previously regarding the link between serum albumin and outcome of stroke have proven that albumin is a 'go to parameter' in prognosticating the short term outcome. Thus a person with a good nutrition has a normal albumin level with good prognosis in cases of acute ischemic stroke. Therapeutic methods have also been tried by infusing human albumin in stroke patients and follow up regarding functional and early recovery has been done. But the benefit of albumin infusion is not of much success; displaying that pre stroke nutritional state plays a very important role in prognosis of the stroke.[59]

Normal range of serum albumin is 3.5 – 5.5 g/dl.[53]

Serum Uric Acid:

Serum Uric acid (UA) is the end product of metabolism of purines in humans.[60] and furthermost the abundant 'aqueous antioxidant'.[61] Uric acid acts as an important scavenger of reactive oxygen species that is produced by nitrogen and oxygen, thus showing off its neuro-protective nature.[62] Hence serum UA might stand as an imperative element of stroke susceptibility. It can be measured at the end of 1 week of admission or after 1 month to 3 months of discharge. The improvement in activities of daily living can be correlated with its values.[63]

Some research conducted before suggest serum Uric Acid was protective in nature for the prognosis of acute ischemic stroke.[64–66] Whereas few authors indicated that it had no such beneficial effect[67,68] and majority researchers stated that there is an increased risk of poor outcome and future vascular events after an episode of acute stroke.[69,70] It is well known fact that Uric Acid levels are more in male gender when compared with females; this difference is clinically seen due to increased preponderance of cardiovascular disease incidence in males.[71–73]

Normal range of serum uric acid is 3 – 7 mg/dl.[53]

Relevant Articles to this Study:

Dr. Sivasubramaniyam S et al.[74] studied the role of Serum Calcium, Serum Albumin and Serum Uric acid as predictors of neurological severity and short term outcome in acute ischemic stroke in their 100 patients; who were > 40 years and presented within 72 hours of stroke onset. Their history included details regarding all the risk factors of stroke with neurological examination. They compared all the 3 parameters with National Institute of Health Scoring System (NIHSS) initially at admission and found; Hypocalcemia in 60% cases with 56% cases out of 100% having NIHSS score > 10. Hypoalbuminemia in 56% cases and all having NIHSS score >10. Hyperuricemia observed in 55% patients. 51 cases of hyperuricemia had NIHSS score >10. The P-value (<0.001) was statistically significant in all the 3 parameters in concern with NIHSS. They used Barthel index as a tool to assess functional outcome of these patients at discharge. Barthel score was <60 in regards to all the 3 parameters of study. That is <60 in 87.5% of hypocalcemic patients, in 86% of patients with hypoalbuminemia, and 84.4% patients of hyperuricemia. Again the P-value (<0.001) was statistically significant with all 3 study parameters and Barthel index at discharge. With this highly significant correlation, they concluded that all the 3 parameters (serum calcium, serum albumin and serum uric acid) can predict the initial neurological severity and also predict the short term outcome in case of ischemic stroke. Further concluded that serum uric acid acts a marker of the magnitude of cerebral infarction and can be used as an independent predictor of acute ischemic stroke outcome.

Abha Gupta et al.[75] conducted a study titled “Correlation of serum calcium levels with severity and functional outcome in acute ischemic stroke patients” with

the aim of determining the usefulness of serum calcium level in assessing the severity and outcome of patients with acute ischemic stroke. Their study included 50 patients between the age group of 20 to 80 years, dividing them into 4 quartiles based on albumin corrected calcium levels. These quartile groups were compared with NIHSS score initially and with MRS score at discharge as well as at the end of 3 months. Results found were that, the higher levels of calcium had lesser stroke severity & better prognosis than the lower calcium quartiles. Q3 & Q4 had 72.73% & 42.86% cases in mild NIHSS category. Also <27.27% (Q3) & 7.14% (Q4) were in <3 grade of MRS. Kruskal-Wallis test was done to check for the association between serum calcium and NIHSS, and found statistically significant p-value of <0.01. Bivariate analysis was used to compare serum calcium and MRS scores, that also was statistically significant (P-value <0.01). Thus they concluded that, the severity of stroke varies based on the levels of serum calcium. Severity of stroke is more at the lower levels than at higher levels. And functional outcome also varies with its level, similar to that of severity. Thus serum calcium acts as a marker of initial neurological severity and short term outcome in cases of ischemic stroke.

A study named "Elevated Calcium after acute ischemic stroke: association with a poor short term outcome and long term mortality" by Jong-won Chung, Wi-Sun Ryu et al.[76] conducted in Seoul National University Hospital, South Korea. Here also all patients (N=1915) were subjected to initial neurological examination with NIHSS scale; detailed history regarding age, sex, family history, past history and risk factors were analyzed. The modified Rankin scale was used to assess the functional outcome at discharge like the above 2 articles. Ordinal logistic regression analysis was used to correlate MRS and albumin corrected calcium levels. The mean Serum calcium level at admission was 8.97±0.58 and mean albumin corrected calcium was

9.07±0.49. There was significant association between, the albumin corrected calcium and long term mortality. Thus they concluded; 'elevated levels of serum calcium (albumin corrected) is associated with poor short term outcome and greater risk of long term mortality after acute ischemic stroke'.

A study by Bruce Ovbiagele, Sidney Starkman et al.[77] that included Serum calcium measurement at baseline and at 3 to 4 days of stroke onset, was taken as the prognosticating parameter in case of acute ischemic stroke. This was a modified Repinotan Randomized Exposure Controlled trial (mRECT), which included 826 participants. Pearson correlations, bivariate and multivariate analysis was done. Results of 80% subjects who completed the baseline data and trial was analyzed. Calcium was divided into quartiles depending on the serum levels. The only significant outcome obtained in their study was that the delayed levels (at 3-4 days) of calcium in the higher quartile had a better prognosis and 3 monthly functional outcome compared to the lower quartile group. The barthel index was also more in the delayed higher quartile group (76.9, $p = 0.006$) at the end of 3 months that that of early calcium levels (at baseline). The MRS scale also showed the same results of Barthel index. Thus they concluded that the elevated levels of serum calcium at 72 – 96 hours of stroke onset, independently predicts a better outcome at the end of 3 months. Thus delayed calcium levels can be taken as the prognosticator in cases of acute ischemic stroke. Similarly the calcium level estimated at admission has no role in detecting the short term outcome in these cases.

Another study that tried to correlate the levels of serum calcium with 'clinical and radiological' aspects of acute ischemic stroke was undertaken by Gaurav M kasundra, Isha Sood et al.[78] This was an observational study that included 50 patients

aged more than 40 years of acute ischemic stroke. The Pearson's correlation coefficient was used to statistically analyze NIHSS, infarct size and Barthel index with albumin corrected calcium levels. Different subgroups based on location of infarct were also compared with other parameters. Mean corrected Calcium value was 9.47± 0.78 mg/dl. The mean NIHSS score at admission was 10.64±7.9. Mean Barthel index score at end of 1 week was 57.2±37.5. It was found that corrected calcium had a significant correlation with only barthel index and infarct size, but not with NIHSS. At the same time total serum calcium had a significant association with all the stroke assessment scales. Thus their conclusion is that for looking at early recovery (at the end of 1st week) serum calcium, but not albumin corrected calcium has to be taken into consideration. Higher calcium levels have better prognosis with smaller infarct size.

Albumin correlating to acute ischemic stroke, study was done by Sharma V, Giri S et al. in UCMS & GTB hospital, Delhi.[79] 120 patients were included in this study. Similar to the above mentioned studies, initially NIHSS is done to assess the neurological severity and Barthel index is used to assess functional outcome at the end of 1 week. Mean age was 65.03±13.08 years, 39.17% were chronic tobacco smokers, among comorbidities 55% were hypertensive, 22.5% diabetics and 16.67% had coronary disease. The mean albumin level was 3.73±0.41 mg/dl. The average score of NIHSS was 11.1 and barthel index was 56.48. Analyzing the values of the study, they found that serum albumin was negatively correlated with the initial assessment (NIHSS). Higher serum albumin levels had lesser severity at admission, solely depending on the good nutritional status of the patient. Similar result was also seen with the barthel index at the end of 1st week. P value obtained was < 0.001. The conclusion of their study was that, albumin is an essential part of ischemic stroke in

reducing its severity and also a prognostic indicator showing better outcomes at short term (in this case 7 days).

Reeta James, Jog Antony et al.[80] also studied Serum albumin as a prognostic indicator in cases of acute ischemic stroke to evaluate its usefulness in interpreting the short term outcome. This prospective observational study done over 1 year included 100 patients. Instead of utilizing NIHSS, here they used SSS scale (Scandinavian Stroke Scale) as the severity recording scale. The Pearson correlation was applied and the comparison between Albumin and SSS scale yielded a positive correlation with Pearson coefficient of 0.558 and the P value of <0.05. Indicating that, higher levels of serum albumin had a lesser severity at admission. The short term outcome at the end of 7 days was analyzed using modified rankin scale. Statistically Pearson correlation coefficient was – 0.70, which was significant for a positive correlation between them. All other factors of study (Age, Sex, Infarct site, habits and risk factors) were compared with serum albumin. Finally they concluded that serum albumin had no much variation with gender and age. Nutritional status indicator albumin also has a role in predicting the outcome to certain extent when ischemic stroke patients are followed up for a shorter duration. Thus infusing albumin during the treatment of stroke can be beneficial for better recovery.

In an analogous study about serum albumin in validating the prognosis of acute ischemic stroke conducted in Egypt by Adel Hamed Elbaih et al.[1] 60 cases were studied. Again Scandinavian Stroke Scale (SSS) was used to analyze initial neurological severity at admission. And also this scale was used to record the outcome of the patient by the end of 28 days. Majority of the patients had mild stroke in the study population, 55%. 40% had moderate severity and only few (5%) had severe

stroke. This study also recorded the survival of the patients with hypoalbuminemia. Severe stroke patients all had low albumin levels and were admitted in ICU. Patients with normal levels or higher levels of albumin had minor stroke and were admitted in normal ward with earlier discharge and better prognosis. Specificity was 83% and Sensitivity was 100% for serum albumin in establishing the severity of the stroke initially, whereas SSS scale had similar numbers in prognosticating the patients during follow up. Thus demonstrating the beneficial effects of serum albumin as a simple tool in short term prognosis of stroke patients.

Clinical outcome analysis in association with Serum Albumin in acute ischemic stroke, was demonstrated in another study by Santni Manickam, Joel Franklin et al.[81] like other stated study data above, this study also had NIHSS and MRS grading systems for analyzing the severity and prognosis of the study population. Only 1 parameter was kept in mind to prove the association. The results showed that the better levels of serum albumin along with lower NIHSS and MRS scores had better prognosis. One important point was also included before quoting the conclusion - the impact of infarct volume on the recovery of the patient. Smaller infarct volumes played a significant role in good prognosis than the infarcts with large volume. Thus they concluded that, there is a definite role of serum albumin in prognosis of the patient, and it can be used as one of the tools to weigh the consequence.

Coming to a study related to Uric Acid, the descriptive analytical cross sectional study was undertaken by Payam Saadat, Alijan Ahmadi Ahangar et al[82] in their 170 patients. 57% patients had uric acid levels within normal range, 18% had hyperuricemia and 25% patients had below normal levels of uric acid. They also

estimated the levels of serum magnesium, which inversely correlated with serum uric acid levels in acute ischemic stroke. They correlated serum uric acid with all the demographic factors, risk factors of ischemic stroke and NIHSS scores at admission. According to the results they got, they concluded that serum uric acid is not an independent risk factor in estimating the outcome and prognosis. And also the recovery of stroke patients is not depending on the influence of uric acid on demographic factors. They finalized their impression that, more than uric acid magnesium has some prognostic influence in acute ischemic stroke.

A multi-centric registry named "PREMIER study" regarding studies on acute ischemic stroke was directed and this research was conducted by Erwin Chiquete, Jose L Ruiz, Sandoval et al.[83] with 463 study patients. Similar to other studies mentioned earlier, this study also utilized NIHSS scoring system in grading the severity of acute ischemic stroke at admission. Along with this MRS scale was used to assess functional grading at discharge and 1.5 years of post-discharge follow up at 1 month, 3, 6, 12 and 18 months. Mean serum uric acid level at admission was 6.1±3.7 mg/dl. Uric acid levels <4.5 mg/dl had good outcome during the follow up period of 1 month. Whereas the further follow up was not associated with any significant correlation. They also found that uric acid levels had lesser predilection to female gender and young age in their study population. NIHSS severity was more in cases with hyperuricemia. Thus they concluded, the role of serum uric acid is only present in stating the infarct volume and initial neurological severity; but not as an independent predictor of prognosis in acute ischemic stroke.

STUDY DESIGN AND METHODOLOGY

Study design and Methods

❖ Study Design:

- A one year hospital based Observational cross sectional study
- Period of study:- 1st January 2020 to 31st December 2020
- Source of Data:- Patients admitted in the wards and ICU of Departments of General Medicine and Neurology at KLES Dr.Prabhakar Kore Hospital, Belagavi fulfilling the inclusion criteria.

❖ Inclusion Criteria:

All adult patients > 18 years of age presenting with cerebrovascular accident and proved as ischemic stroke on CT scan or MRI scan within 24 hours of stroke.

❖ Exclusion Criteria:

- Hemorrhagic stroke
- Patients with known hepatic/renal diseases
- Patients on diuretics and drugs causing hyperuricemia
- Patients on hepatotoxic/nephrotoxic drugs

❖ Methodology:

- Patients admitted at KLES hospital with acute ischemic stroke as confirmed by CT/MRI Brain will be included in the study.
- Informed consent will be obtained.
- Institutional ethical clearance has been obtained.
- A detailed history will be taken and clinical features assessed.
- Basic laboratory tests are conducted such as complete blood counts, liver function tests, renal function tests, urine routine and microscopy.
- National Institute of Health Stroke Scale, serum calcium, serum albumin and serum uric acid levels will be tested at the time of admission.
- Modified Rankin scale will be performed at the end of first week.
- All the patients fulfilling the inclusion criteria and willing to participate will be included in the study.

❖ Sample size:

- calculated using the formula

  $N = za2\ P(1-P) / d2$

  For a 5% level of significance, za is 1.96

  P is the prevalence of the disease which is 20%

  d is the percentage likely difference in the prevalence which is 10%.

- On application N = 64 and a sample size of 65 is considered.
- Sample method: Purposive sampling.
- All consecutive patients fulfilling the inclusion criteria will be included in the study.

❖ Statistical analysis:

- For the continuous quantitative variables mean and standard deviation will be calculated. The inter group continuous variables will be compared using suitable tools of statistics like unpaired student's t test. Two quantitative variables, within a group, will be compared using student's paired t test.
- Discrete variables will be represented by median. Suitable graphs will be used to depict the comparison.
- The categorical data was expressed in terms of rates, ratios and percentages. The association between the outcome, clinical and demographic characteristics will be tested using Chi-square test or Fisher's exact test.
- For all the tests the value of p less than 5% (0.05) will be considered significant.

RESULTS

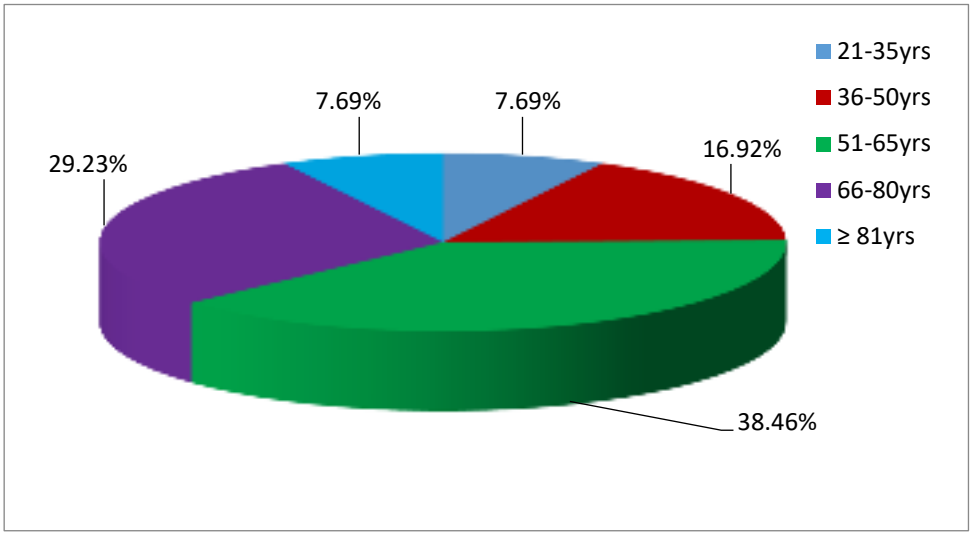
The present study was conducted on 65 patients who were subjected to Serum Calcium, Serum Albumin and Serum Uric acid estimation, as markers of initial neurological severity and short term outcome indicators in acute ischemic stroke at KLE's Dr Prabhakar Kore Hospital and Medical Research Centre, Belagavi during the period of January 2020 to December 2020.

Table 3: Age wise distribution of patients

Age Groups	Number of Patients	Percentage
21 - 35 years	05	07.69 %
36 – 50 years	11	16.92 %
51 – 65 years	25	38.46 %
66 – 80 years	19	29.23 %
≥ 81 years	05	07.69 %
TOTAL	**65**	**100.0**

MEAN: 59.98 ± 15.44

Figure 1: Age wise distribution of patients

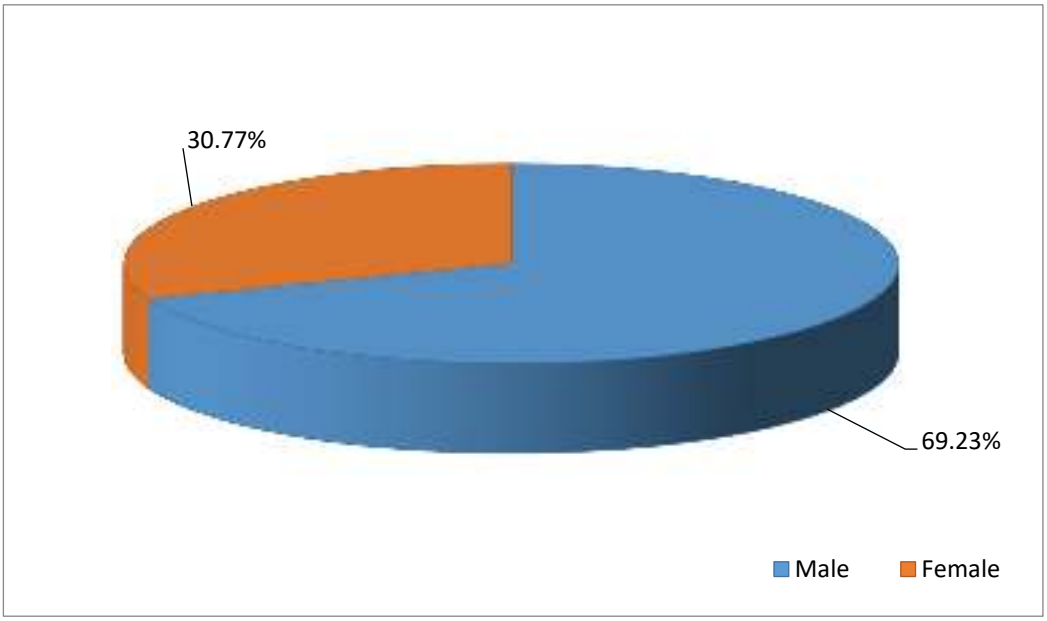


In the present study maximum of patients were in the age group of 51-65 years, that is 25 (38.46%), 19 patients (29.23%) were in the age group of 66-80 years, 11 patients (16.92%) were in the age group of 36-50 years and 05 patients (7.69%) each in the age group of 21-35 years and >80 years of age. In the present study, youngest patient was 22 years and the oldest patient was 89 years of age. The Mean age group was 59.98 ± 15.44 years.

Table 4: Sex wise distribution of patients

Gender	No of Patients	Percentage of Patients
Male	45	69.23 %
Female	20	30.77 %
Total	**65**	**100.00**

Figure 2: Sex wise distribution of patients

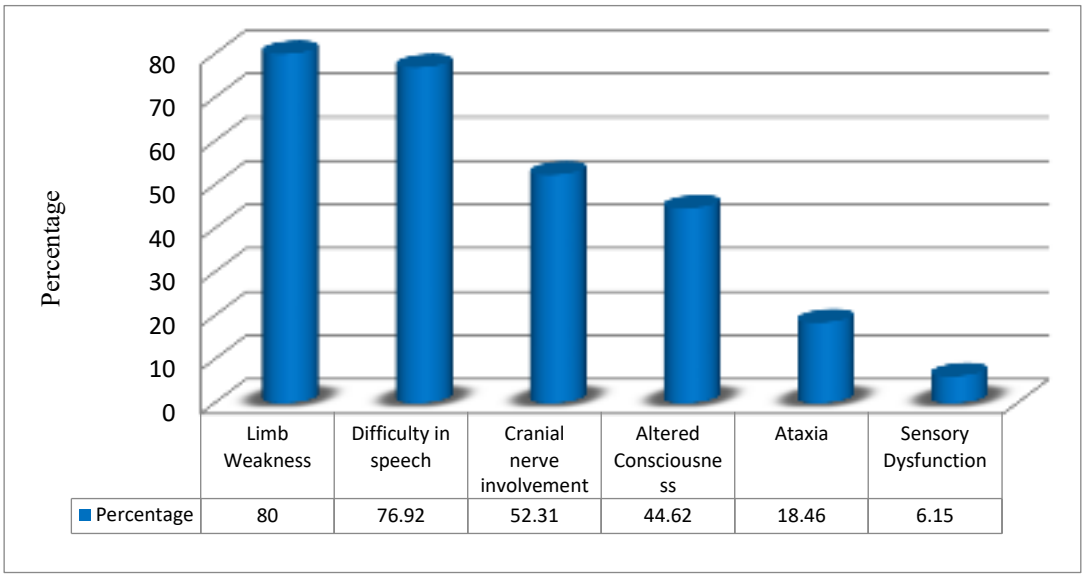


In our present study of 65 patients, 45 were males (69.23%) and remaining 20 were females (30.77%). Male preponderance was seen with male to female ratio of 2.25 : 1

Table 5: Distribution of patients based on Clinical presentation.

Clinical presentation	No of Patients	Percentage of Patients
Limb weakness	52	80.00 %
Difficulty in Speech	50	76.92 %
Cranial nerve involvement	34	52.31 %
Altered consciousness	29	44.62 %
Ataxia	12	18.46 %
Sensory Dysfunction	4	6.15 %

Figure 3: Distribution of patients based on Clinical presentation

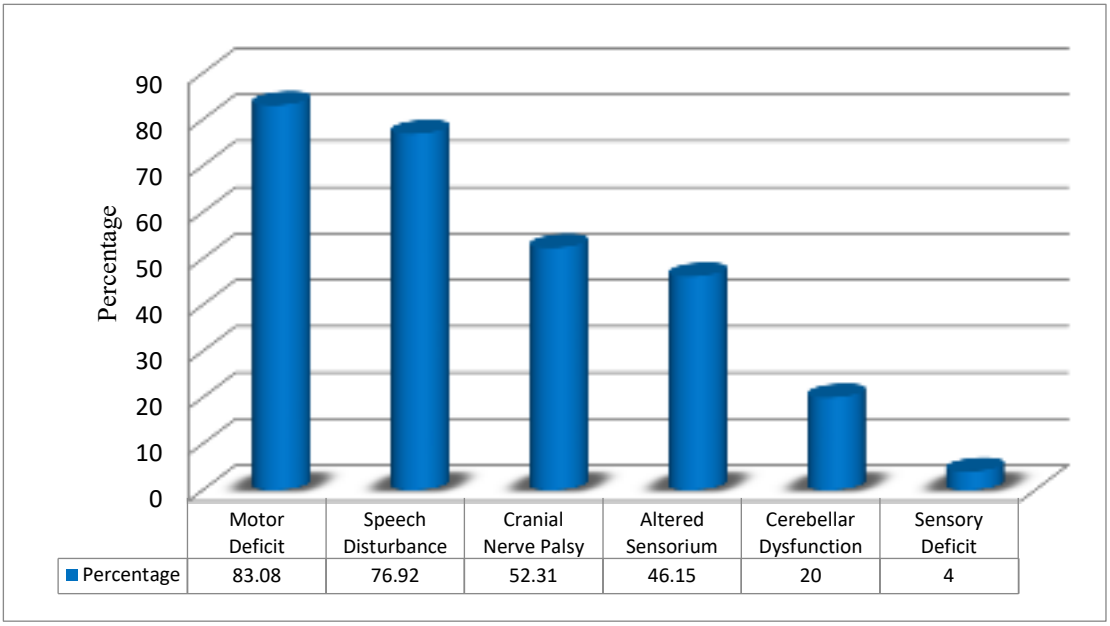


In our study we observed most of the patients presented with limb weakness, that is 52 patients (80%), speech difficulty 50 patients (76.92%), cranial nerve dysfunction 34 patients (52.31%), altered consciousness 29 patients (44.62%), ataxia 12 patients (18.46%) and 04 patients had sensory loss (6.15%). Most of these patients had one or the other overlapping symptoms which is not depicted in the above table.

Table 6: Distribution of patients based on Clinical signs

Clinical signs	No of Patients	Percentage of Patients
Motor Deficit	54	83.08 %
Speech Disturbances	50	76.92 %
Cranial nerve Palsy	34	52.31 %
Altered Sensorium	30	46.15 %
Cerebellar Dysfunction	13	20.00 %
Sensory Deficit	4	6.15 %

Figure 4: Distribution of patients based on Clinical signs

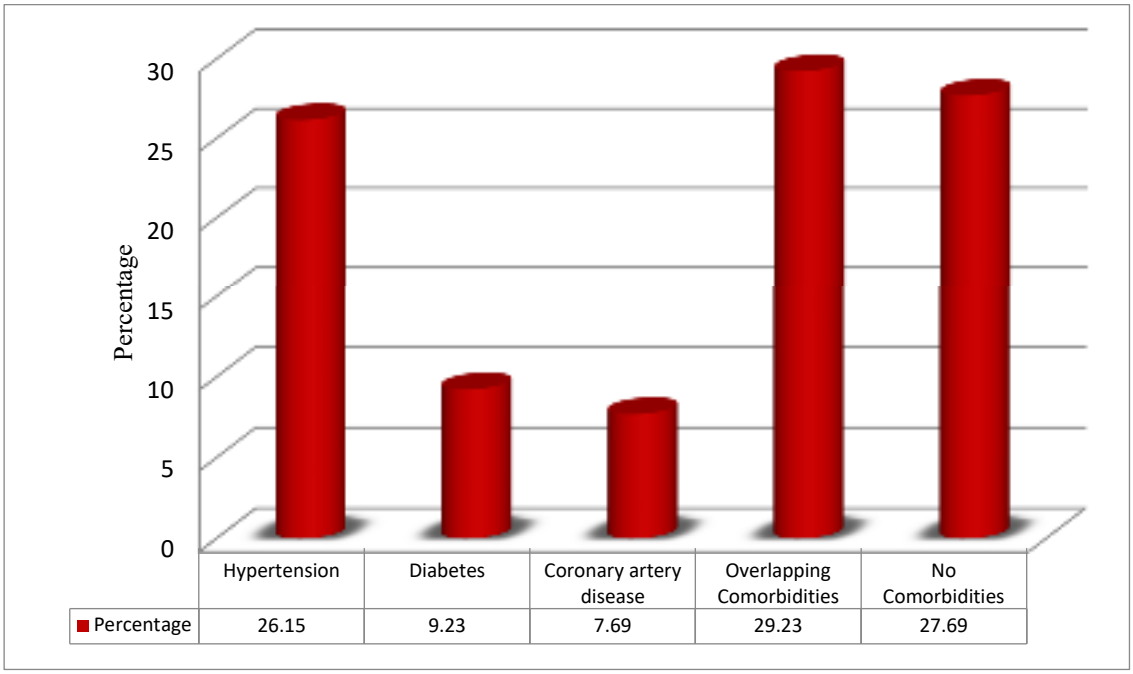


In our study of 65 patients, patients presented with varying neurological deficits in the form of motor deficits 54 (83.07%), speech disturbance 50 (76.92%) ranging from mild dysarthria to global aphasia, cranial nerve palsy 34 patients (52.31%), altered sensorium 30 patients (46.15%) ranging from mild disorientation to stupor but no one had coma. 13 patients (20%) had ataxia and sensory deficit was observed in 04 patients (6.15%).

Table 7: Distribution of patients based on Co-morbidities

Co-morbidities	No of Patients	Percentage of Patients
Hypertension	17	26.15 %
Diabetes	6	9.23 %
Coronary disease	5	7.69 %
Overlapping Comorbidities	19	29.23 %
Nil Comorbidities	18	27.69 %
Total	**65**	**100.00**

Figure 5: Distribution of patients based on Co-morbidities

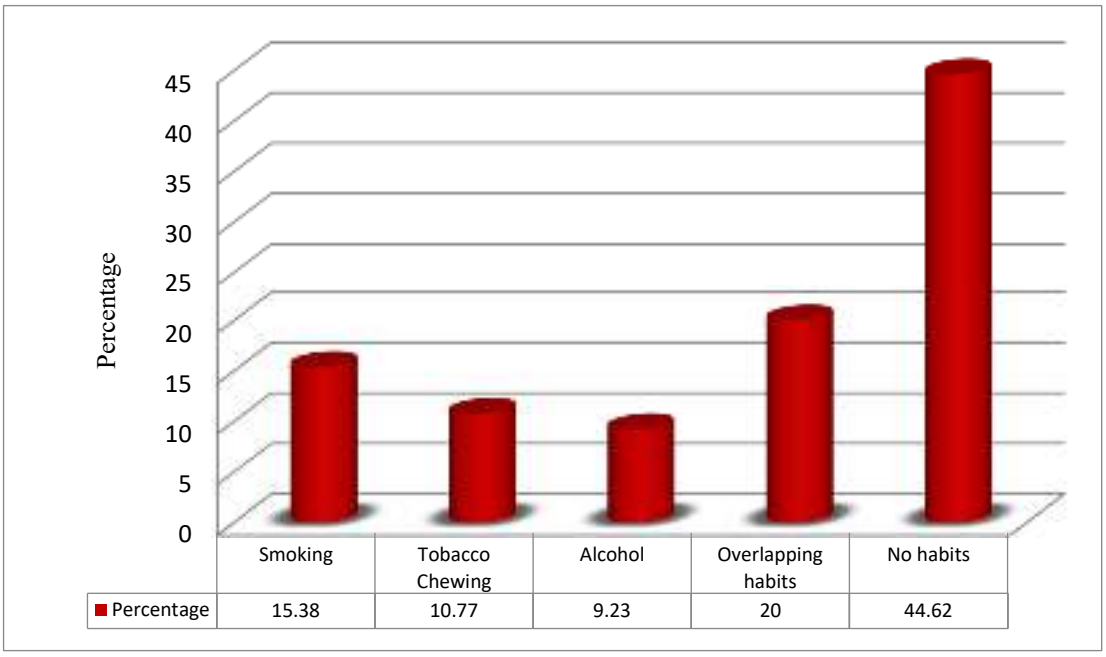


Majority of the patients had comorbidities, that is hypertension 17 patients (26.15%), 06 patients (9.23%) had diabetes mellitus, 05 patients (7.69%) had coronary artery disease, 19 patients (29.23%) had overlapping comorbidities and 18 patients (27.69%) had no comorbidities.

Table 8: Distribution of patients based on Habits

Habits	No of Patients	Percentage of Patients
Smoking	10	15.38 %
Tobacco chewing	7	10.77 %
Alcohol	6	9.23 %
Overlapping habits	13	20.00 %
Nil habits	29	44.62 %
Total	**65**	**100.00**

Figure 6: Distribution of patients based on Habits

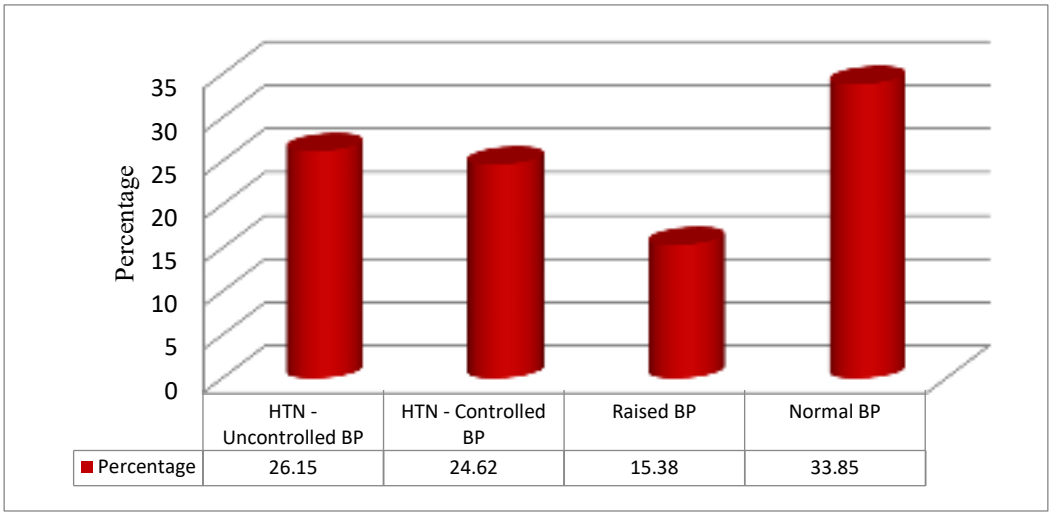


In our study 10 patients (15.38%) were chronic smokers, 07 patients (10.77%) were tobacco chewers, 06 patients (9.23%) were chronic alcoholics, 13 patients (20%) had overlapping habits and 29 patients (44.61%) did not have any habits as depicted in the above table.

Table 9: Blood pressure measurements on admission

Hypertension	Blood pressure	No of Patients	Percentage of Patients	Mean BP	SD BP
Hypertensive	Uncontrolled BP	17	26.15 %	157.18	9.57
	Controlled BP	16	24.62 %	120.63	17.31
	Total	33	50.77 %	139.45	23.03
Non-hypertensive	Raised BP	10	15.38 %	165.60	19.11
	Normal BP	22	33.85 %	123.45	17.01
	Total	32	49.23 %	136.63	26.38

Figure 7: Blood pressure measurements on admission

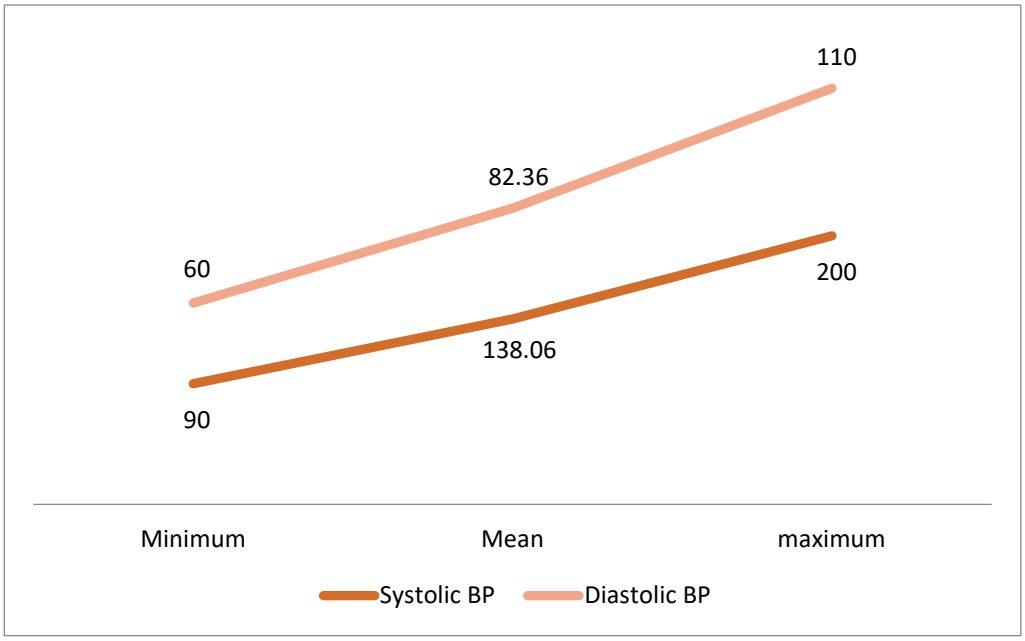


In our study among the hypertensive patients, 17 (26.15%) had uncontrolled blood pressure and 16 (24.62%) had controlled blood pressure at presentation. In non-hypertensive patients 10 patients (15.38%) had raised blood pressure at presentation and 22 patients (33.85%) had normal blood pressure. The mean blood pressure in hypertensive and non-hypertensive patients is depicted in the above table.

Table 10: Mean Systolic and Diastolic Blood Pressure

Blood Pressure	Minimum	Maximum	Mean
Systolic BP	90	200	138.06 ± 24.58
Diastolic BP	60	110	82.36 ± 14.37

Figure 8: Mean Systolic and Diastolic Blood Pressure

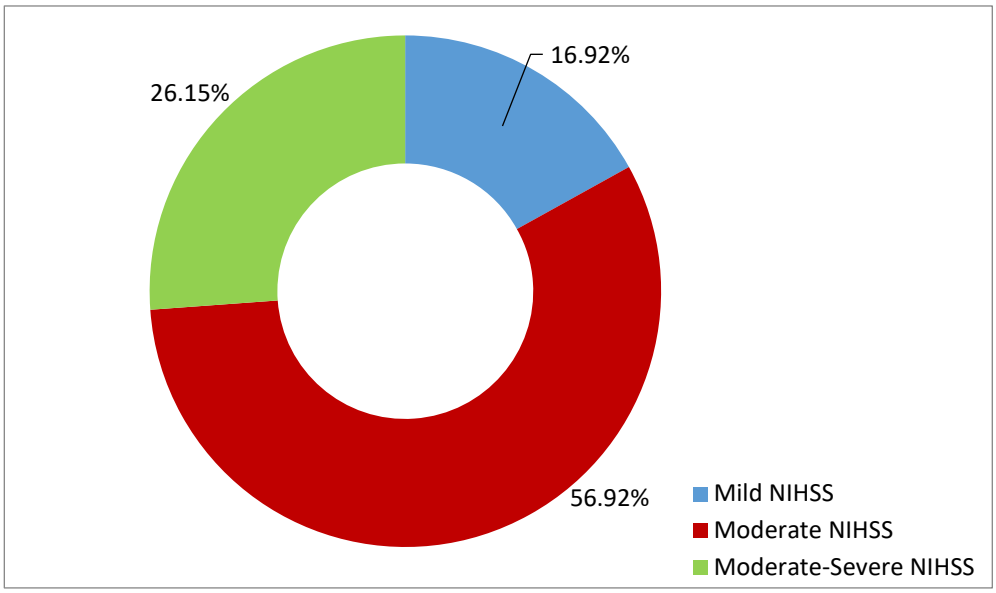


The mean systolic and diastolic blood pressure of all the 65 patients is depicted in the above table.

Table 11: Distribution of patients based on 'National Institute of Health Stroke Scale (NIHSS)' severity

NIHSS Severity	Number of Patients	Percentage Of Patients
Mild	11	16.92 %
Moderate	37	56.92 %
Moderate-Severe	17	26.15 %
Total	**65**	**100.00**

Figure 9: Distribution of patients based on 'National Institute of Health Stroke Scale (NIHSS)' severity

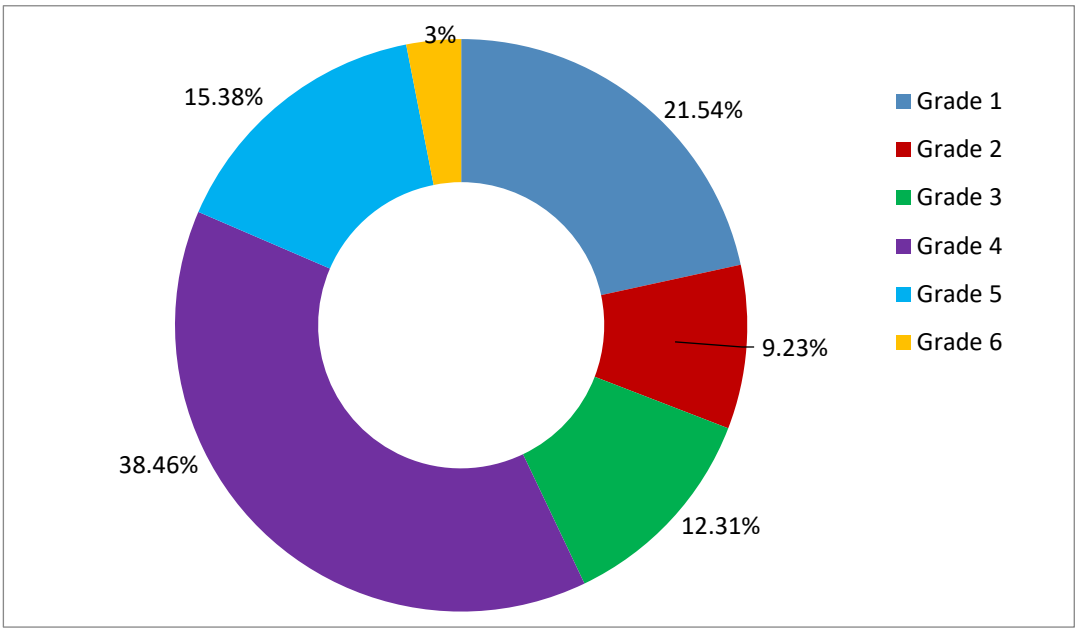


We subjected all our 65 patients to National Institute of Health Stroke Scale (NIHSS) at arrival. Majority of patients were in moderate category that is 37 (56.92%), 17 patients (26.15%) in moderate-severe category and remaining 11 patients (16.92%) were in mild category. No patients were in severe category. Our observations are depicted in the above table.

Table 12: Distribution of patients based on 'Modified Rankin Scale (MRS)' grades at 1 week

MRS Grades	Number of Patients	Percentage of Patients
Grade 1	14	21.54 %
Grade 2	06	09.23 %
Grade 3	08	12.31 %
Grade 4	25	38.46 %
Grade 5	10	15.38 %
Grade 6	02	03.08 %
Total	**65**	**100.00**

Figure 10: Distribution of patients based on 'Modified Rankin Scale (MRS)' grades at 1 week



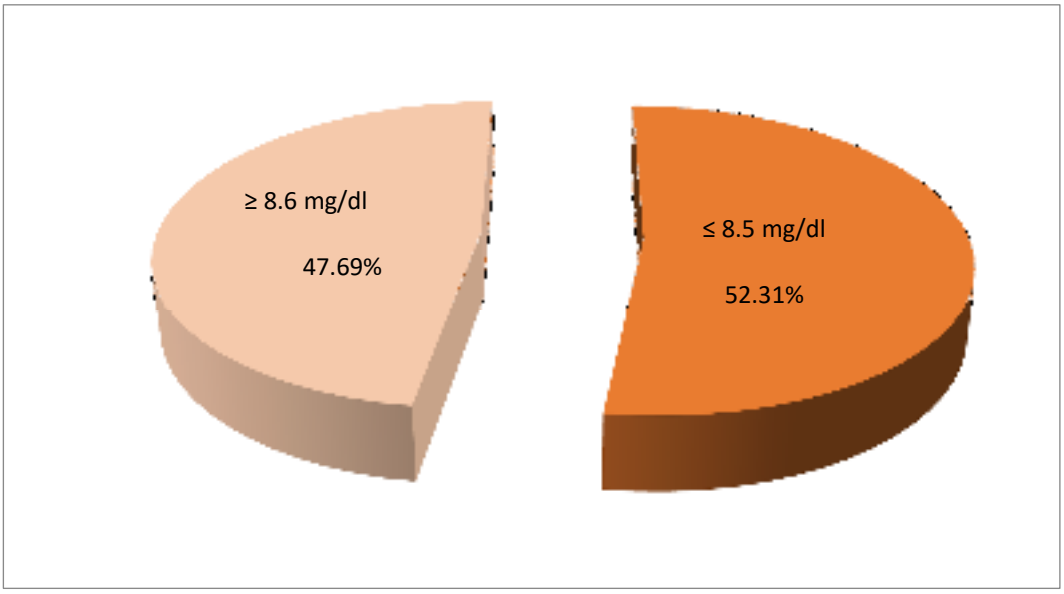
Similarly we attempted to grade our patients as per modified Rankin scale (MRS) grading system at the end of 1 week and found to have the above results as shown in the table.

LAB PARAMETERS

Table 13: Distribution of Patients based on Serum Calcium

Serum Calcium (mg/dl)	No of Patients	Percentage of Patients
≤ 8.5	34	52.31 %
≥ 8.6 (8.6 – 10.2)	31	47.69 %
Total	**65**	**100.00**

Figure 11: Distribution of Patients based on Serum Calcium

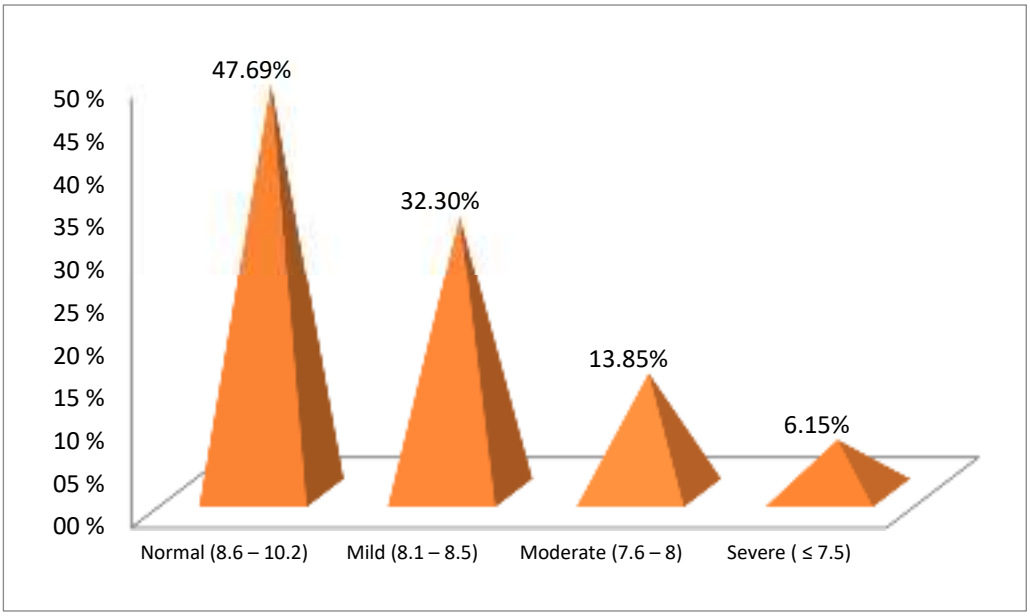


All 65 patients were subjected to serum calcium estimation; 31 patients (47.69%) had serum calcium within normal limits (8.6-10.2 mg/dl) and remaining 34 patients (52.31%) had serum calcium level below 8.6 mg/dl.

Table 14: Distribution of patients based on categorization of Serum Calcium

Serum Calcium levels (mg/dl)	No of Patients	Percentage of Patients
Normal (8.6 – 10.2)	31	47.69 %
Mild (8.1 – 8.5)	21	32.30 %
Moderate (7.6 – 8)	9	13.85 %
Severe (≤ 7.5)	4	6.15 %
Total	**65**	**100.00**

Figure 12: Distribution of patients based on categorization of Serum Calcium

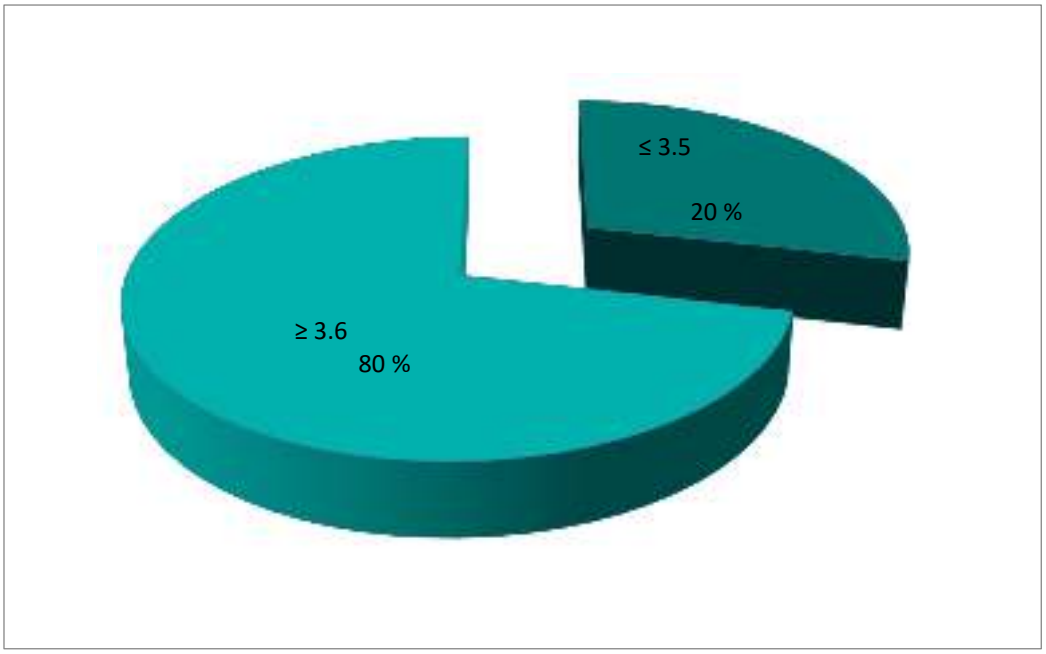


Serum calcium level estimation was further categorized as per severity of depletion of calcium levels in the blood, as depicted in the above table.

Table 15: Distribution of Patients based on Serum Albumin

Serum Albumin (g/dl)	No of Patients	Percentage of Patients
≤ 3.5	13	20 %
≥ 3.6 (3.6 – 5.2)	52	80 %
Total	**65**	**100.00**

Figure 13: Distribution of Patients based on Serum Albumin

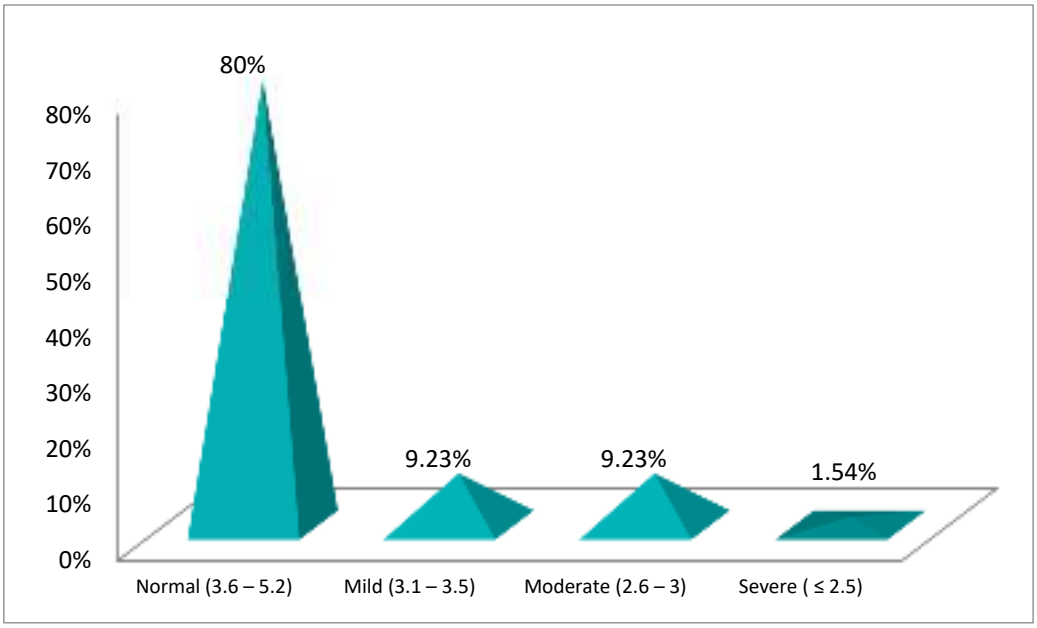


Similarly all cases were subjected for serum albumin level estimation; 52 patients (80%) had serum albumin level within normal limits (3.5-5.2 g/dl) and remaining 13 patients (20%) had albumin level below 3.5 g/dl.

Table 16: Distribution of patients based on categorization of Serum Albumin

Serum Albumin levels (g/dl)	No of Patients	Percentage of Patients
Normal (3.6 – 5.2)	52	80.00 %
Mild (3.1 – 3.5)	6	9.23 %
Moderate (2.6 – 3)	6	9.23 %
Severe (≤ 2.5)	1	1.54 %
Total	**65**	**100.00**

Figure 14: Distribution of patients based on categorization of Serum Albumin

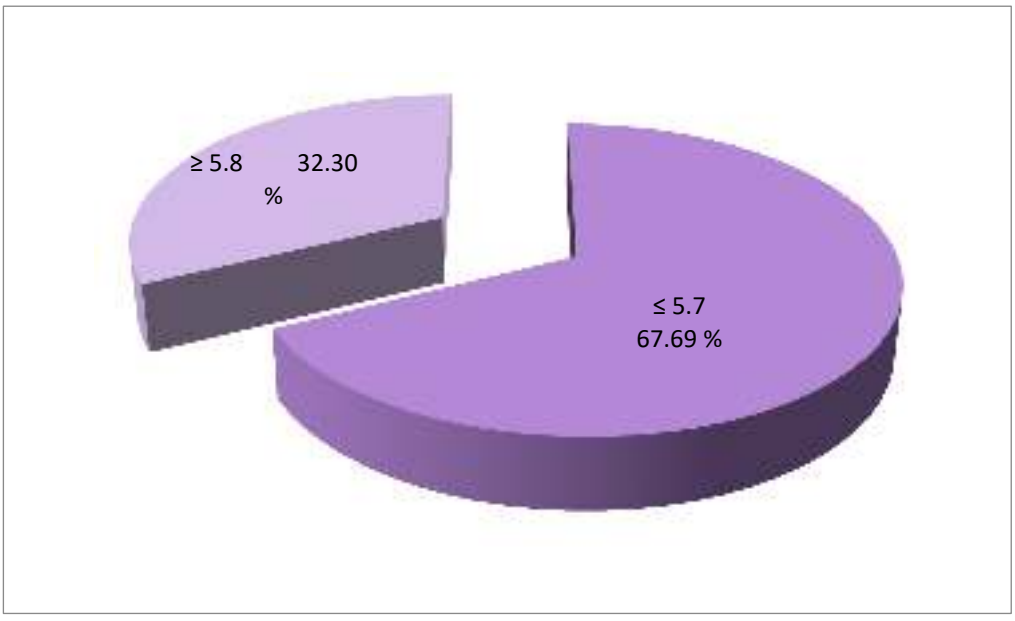


Similarly serum albumin levels were categorized as mild, moderate and severe as shown in the above table.

Table 17: Distribution of Patients based on Serum Uric Acid

Serum Uric acid (mg/dl)	No of Patients	Percentage of Patients
≤ 5.7	44	67.69 %
≥ 5.8	21	32.30 %
Total	**65**	**100.00**

Figure 15: Distribution of Patients based on Serum Uric Acid

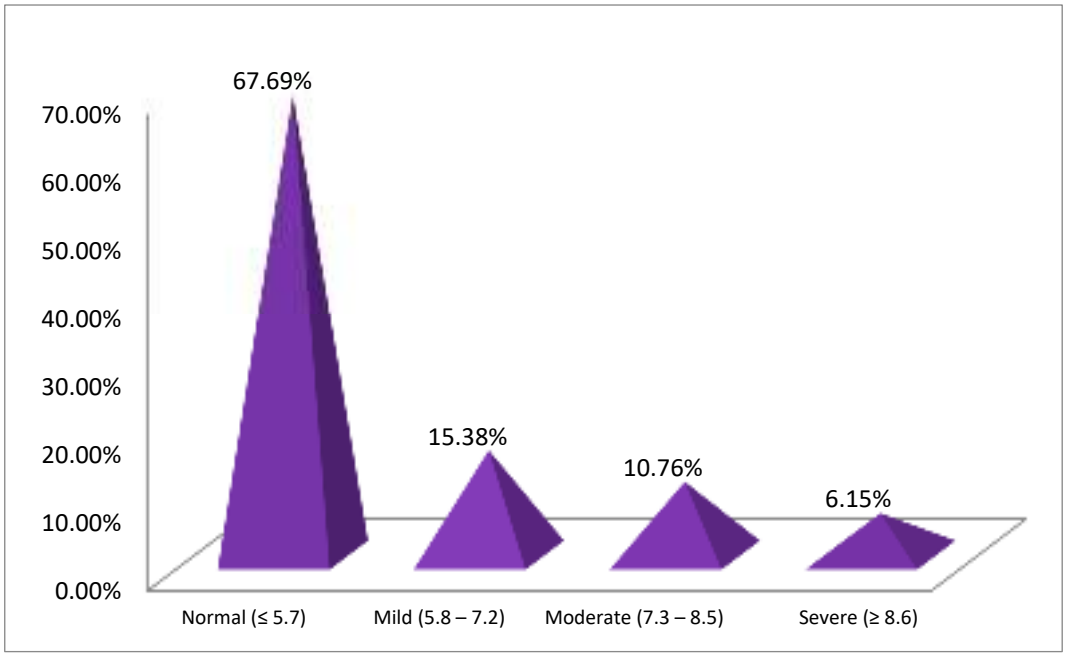


Among the 65 patients; 44 patients (67.69%) had serum uric acid within normal range (2.4-5.7 mg/dl) and remaining 21 patients (32.31%) had abnormal serum uric acid range (>5.7 mg/dl)

Table 18: Distribution of patients based on categorization of Serum Uric Acid

Serum Uric acid levels (mg/dl)	No of Patients	Percentage of Patients
Normal (≤ 5.7)	44	67.69 %
Mild (5.8 – 7.2)	10	15.38 %
Moderate (7.3 – 8.5)	7	10.76 %
Severe (≥ 8.6)	4	6.15 %
Total	**65**	**100.00**

Figure 16: Distribution of patients based on categorization of Serum Uric Acid

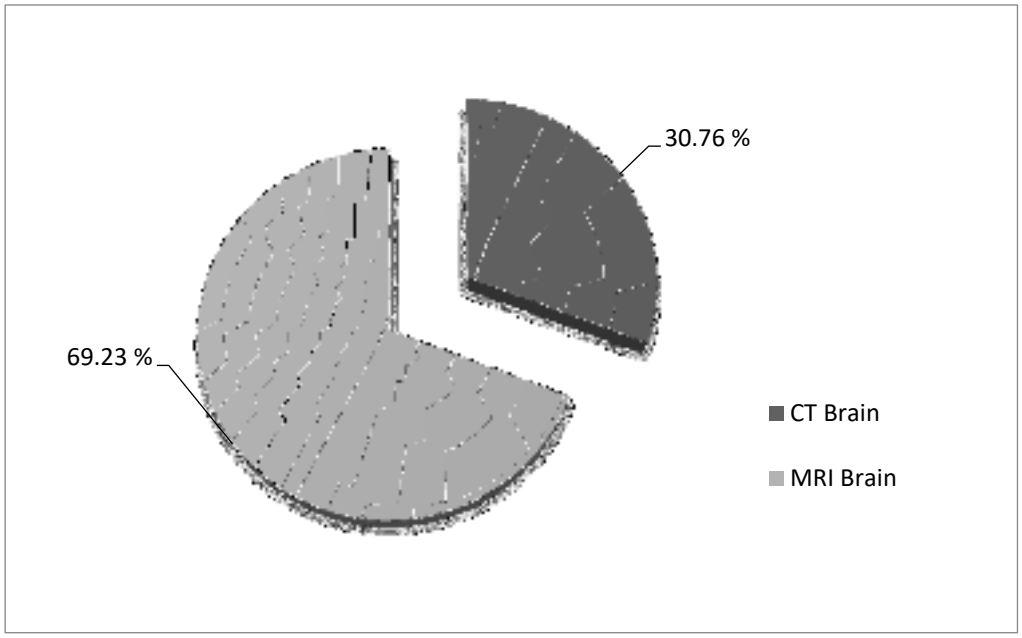


Split up of serum uric acid levels as mild, moderate and severe is depicted in the above table.

Table 19: Distribution of Patients based on Neuroimaging

Neuroimaging	No. of Patients	Percentage of Patients
CT Brain	20	30.76 %
MRI Brain	45	69.23 %

Figure 17: Distribution of Patients based on Neuroimaging

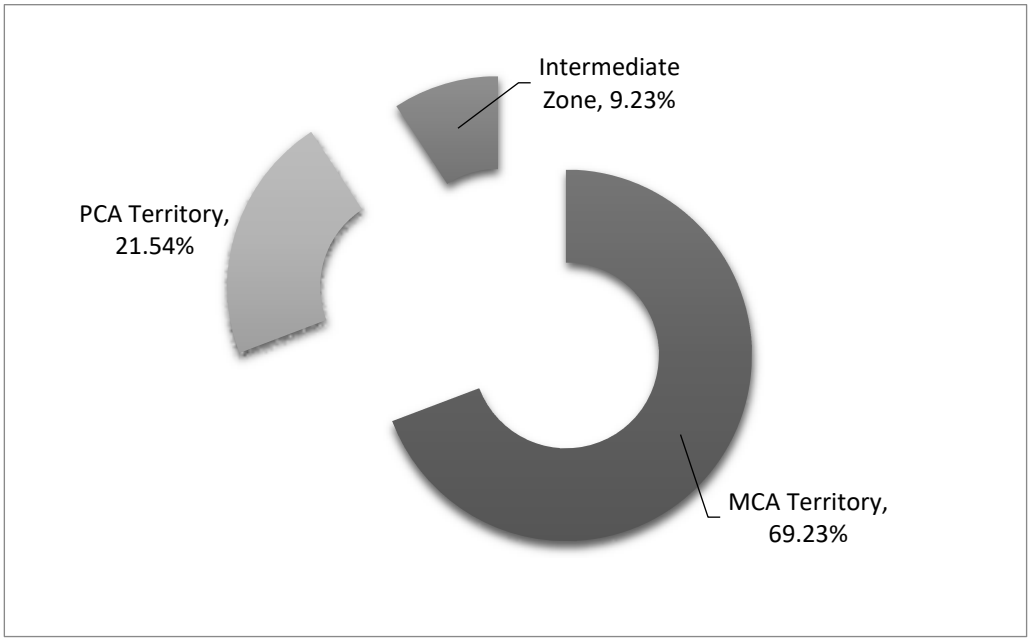


All 65 patients were subjected to either CT or MRI Brain and found to have one or the other lesion on imaging, which is depicted in the above table. 20 patients (30.76%) were subjected to CT Brain and remaining 45 patients (69.23%) were subjected to MRI brain.

Table 20: Distribution of patients based on Vascular Territory Involved

Neuroimaging	No of Patients	Percentage of Patients
MCA Territory	45	69.23 %
PCA Territory	14	21.54 %
Intermediate Zone	6	9.23 %
Total	**65**	**100.00**

Figure 18: Distribution of patients based on Vascular Territory Involved

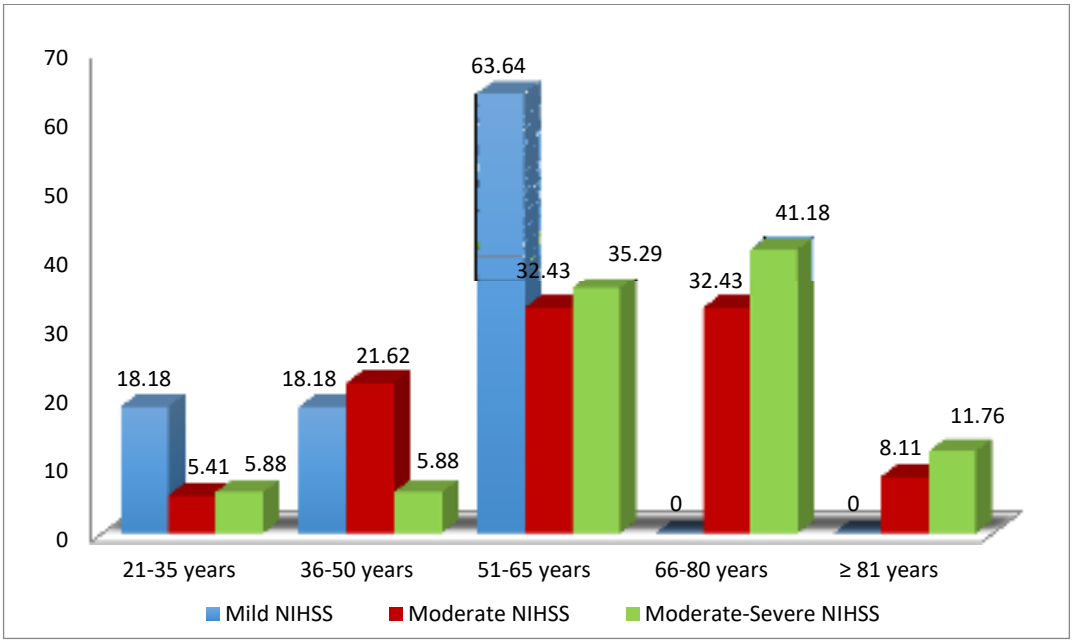


The above table depicts various vascular territories involved, based on CT/MRI findings.

Table 21: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Age groups

Age groups	Mild	%	Moderate	%	Moderate - severe	%	Total	%	χ^2	p-value
21-35yrs	2	18.18	2	5.41	1	5.88	5	7.69	11.21008	0.1900
36-50yrs	2	18.18	8	21.62	1	5.88	11	16.92		
51-65yrs	7	63.64	12	32.43	6	35.29	25	38.46		
66-80yrs	0	0.00	12	32.43	7	41.18	19	29.23		
>=81yrs	0	0.00	3	8.11	2	11.76	5	7.69		
Total	**11**	**100.0**	**37**	**100.0**	**17**	**100.0**	**65**	**100.0**		

Figure 19: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Age groups

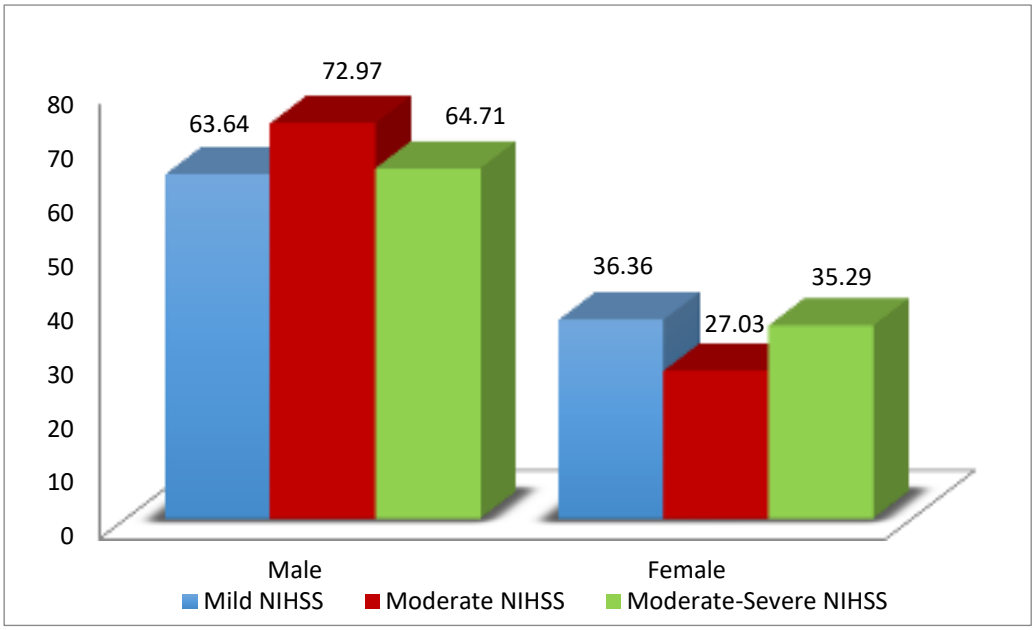


Age was compared with NIHSS scale and further grading of patients by scoring system as mild, moderate and moderate-severe had revealed the findings as shown in the above table. P-value (0.190) was statistically insignificant.

Table 22: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with sex

Sex	Mild	%	Moderate	%	Moderate - severe	%	Total	%	χ^2	p-value
Male	7	63.64	27	72.97	11	64.71	**45**	**69.23**	0.5680	0.7530
Female	4	36.36	10	27.03	6	35.29	**20**	**30.77**		
Total	**11**	**100.0**	**37**	**100.0**	**17**	**100.0**	**65**	**100.0**		

Figure 20: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with sex



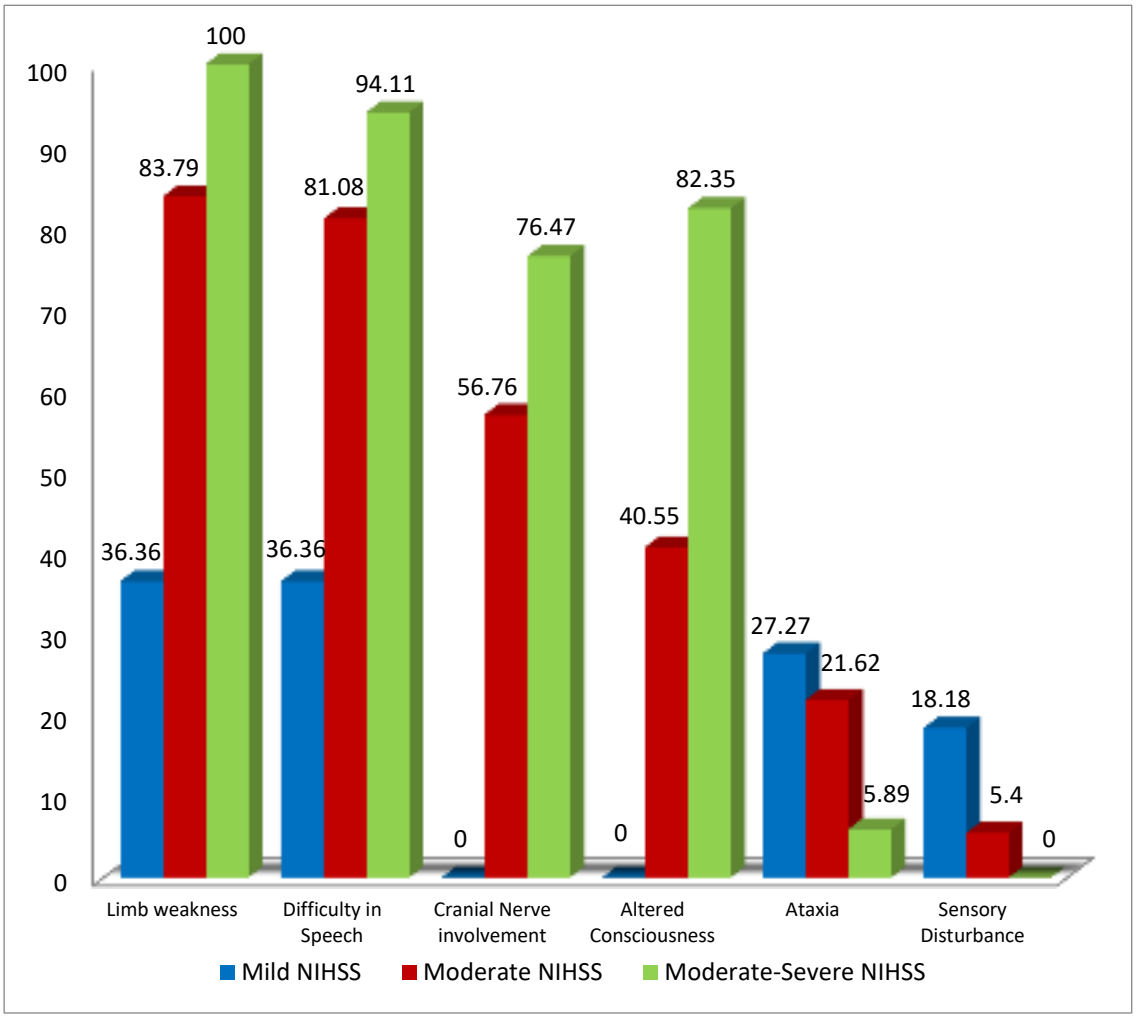
Similarly we tried to compare sex with NIHSS scale and categorized them as mild, moderate and moderate severe which revealed the above findings. P-value (0.753) was statistically insignificant.

Table 23: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with presentation of patients

Clinical presentations	Category	Mild	%	Moderate	%	Moderate - severe	%	Total	%	χ^2	p-value
Limb weakness	No	7	63.64	6	16.21	0	0	**13**	20	17.671	0.000145*
	Yes	4	36.36	31	83.79	17	100	**52**	80		
	Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.00**	**65**	**100.00**		
Difficulty in Speech	No	7	63.64	7	18.92	1	5.89	**15**	23.08	13.385	0.0012*
	Yes	4	36.36	30	81.08	16	94.11	**50**	76.92		
	Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.00**	**65**	**100.00**		
Cranial nerve involvement	No	11	100.00	16	43.24	4	23.53	**31**	47.69	16.336	0.00028*
	Yes	0	0	21	56.76	13	76.47	**34**	52.31		
	Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.00**	**65**	**100.00**		
Altered consciousness	No	11	100.00	22	59.45	3	17.64	**36**	55.38	18.907	7.839
	Yes	0	0	15	40.55	14	82.35	**29**	44.62		
	Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.00**	**65**	**100.00**		
Ataxia	No	8	72.72	29	78.38	16	94.11	**53**	81.54	2.5997	0.272
	Yes	3	27.27	8	21.62	1	5.89	**12**	18.46		
	Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.00**	**65**	**100.00**		
Sensory disturbance	No	9	81.82	35	94.60	17	100.00	**61**	93.85	3.906	0.141
	Yes	2	18.18	2	5.40	0	0	**4**	6.15		
	Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.00**	**65**	**100.00**		

*$p<0.05$

Figure 21: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with presentation of patients



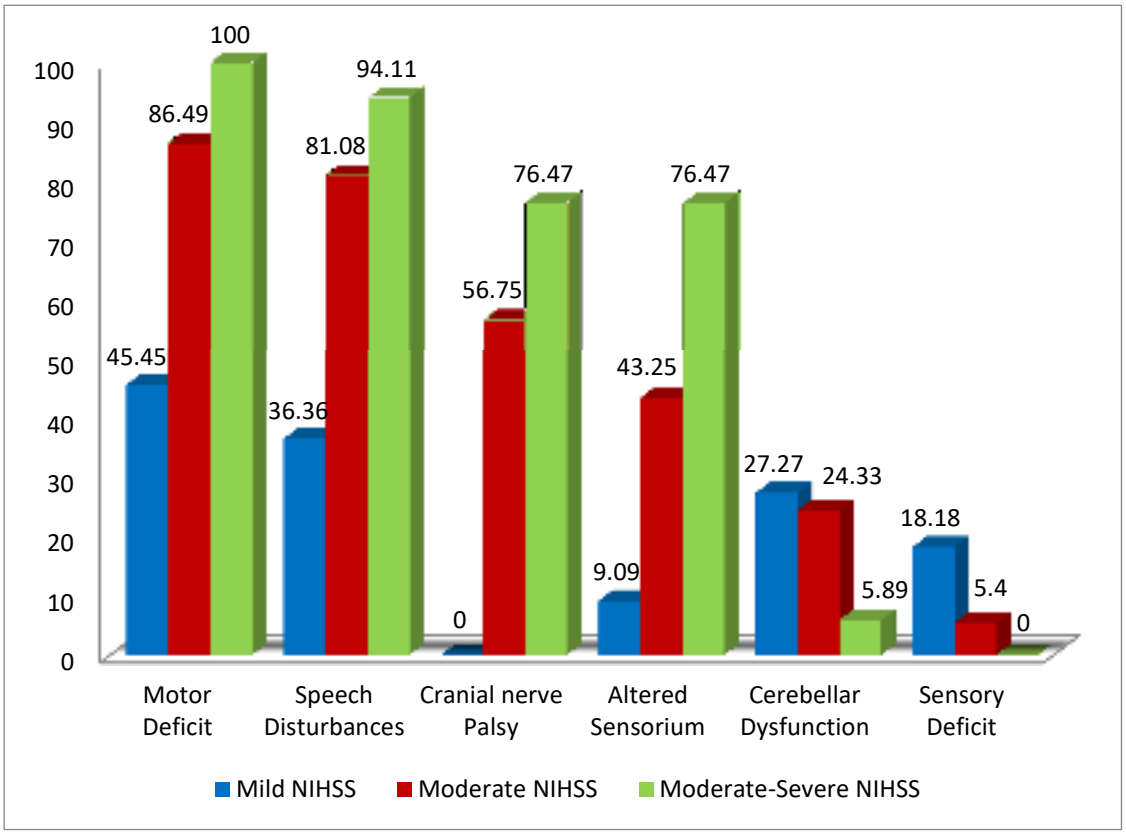
Based on presentation of all 65 patients categorizing as mild, moderate and moderate-severe; P-value was statistically significant with patients presenting with limb weakness (0.00014), difficulty in speech (0.0022) and cranial nerve involvement (0.00028). Other presentations did not demonstrate the statistical significance shown in the above table.

Table 24: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Clinical signs

Clinical signs	Category	Mild	%	Moderate	%	Moderate - severe	%	Total	%	χ^2	p-value
Motor deficit	No	6	54.55	5	13.51	0	0.00	**11**	16.92	14.843	0.00059*
	Yes	5	45.45	32	86.49	17	100.0	**54**	83.08		
	Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.0**	**65**	**100.00**		
Speech Disturbances	No	7	63.64	7	18.92	1	5.89	**15**	23.08	13.385	0.0012*
	Yes	4	36.36	30	81.08	16	94.11	**50**	76.92		
	Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.0**	**65**	**100.00**		
Cranial nerve palsy	No	11	100.00	16	43.25	4	23.53	**31**	47.69	16.336	0.0028*
	Yes	0	0.00	21	56.75	13	76.47	**34**	52.31		
	Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.0**	**65**	**100.00**		
Altered Sensorium	No	10	90.91	21	56.75	4	23.53	**35**	53.85	12.493	0.00193*
	Yes	1	9.09	16	43.25	13	76.47	**30**	46.15		
	Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.0**	**65**	**100.00**		
Cerebellar Dysfunction	No	8	72.73	28	75.67	16	94.11	**52**	80.00	2.913	0.232
	Yes	3	27.27	9	24.33	1	5.89	**13**	20.00		
	Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.0**	**65**	**100.00**		
Sensory Deficit	No	9	81.82	35	94.60	17	100.00	**61**	93.85	3.906	0.141
	Yes	2	18.18	2	5.40	0	0.00	**4**	6.15		
	Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.0**	**65**	**100.00**		

*$p<0.05$

Figure 22: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Clinical signs

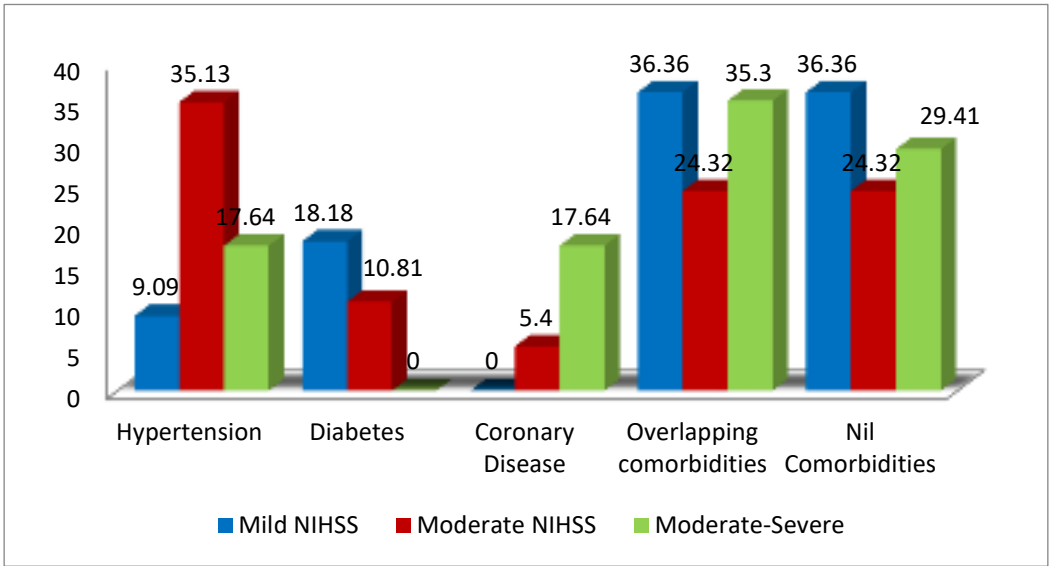


The above table depicts correlation of clinical signs at the time of presentation with NIHSS scoring. It revealed the above findings and P-value was statistically significant in patients with following signs; motor deficits (0.0005), speech disturbance (0.0012), cranial nerve palsy (0.0028) and altered sensorium (0.00193). Statistical significance was not seen with cerebellar dysfunction and sensory deficit.

Table 25: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with co-morbidities

Co-morbidities	Mild	%	Moderate	%	Moderate - severe	%	Total	%	χ^2	p-value
Hypertension	1	9.09	13	35.13	3	17.64	17	26.15	9.926	0.2702
Diabetes	2	18.18	4	10.81	0	0	6	9.23		
Coronary disease	0	0.00	2	5.40	3	17.64	5	7.69		
Overlapping comorbidities	4	36.36	9	24.32	6	35.30	19	29.23		
Nil comorbidities	4	36.36	9	24.32	5	29.41	18	27.69		
Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.00**	**65**	**100.00**		

Figure 23: Comparison of NIHSS severity with co-morbidities

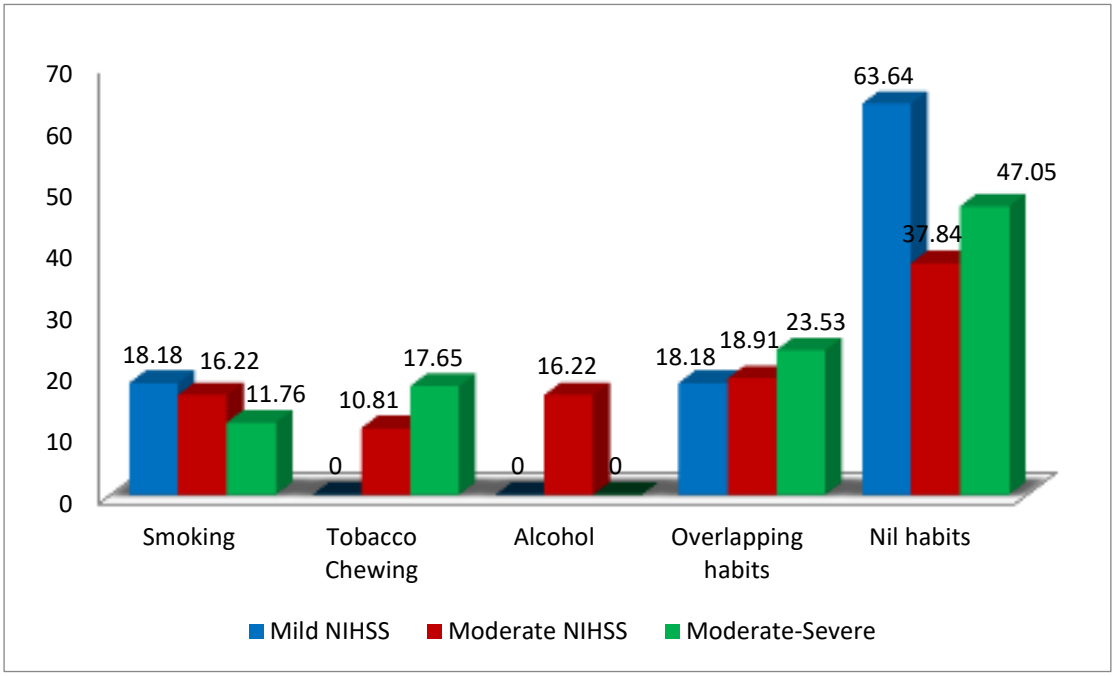


In our study of 65 patients; 17 patients (26.15%) had hypertension, 06 patients (9.23%) had diabetes mellitus, 05 (7.69%) had coronary artery disease, 29 patients (29.23%) had overlapping comorbidity and 18 had (27.69%) no comorbidities. There was no correlation between NIHSS and comorbidities with P-value (0.2702) being insignificant.

Table 26: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Habits

Habits	Mild	%	Moderate	%	Moderate - severe	%	Total	%	χ^2	p-value
Smoking	2	18.18	6	16.22	2	11.76	10	15.38	8.130	0.420
Tobacco chewing	0	0.00	4	10.81	3	17.65	7	10.77		
Alcohol	0	0.00	6	16.22	0	0	6	9.23		
Overlapping habits	2	18.18	7	18.91	4	23.53	13	20.00		
Nil habits	7	63.64	14	37.84	8	47.05	29	44.62		
Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.00**	**65**	**100.00**		

Figure 24: Comparison of NIHSS severity with Habits

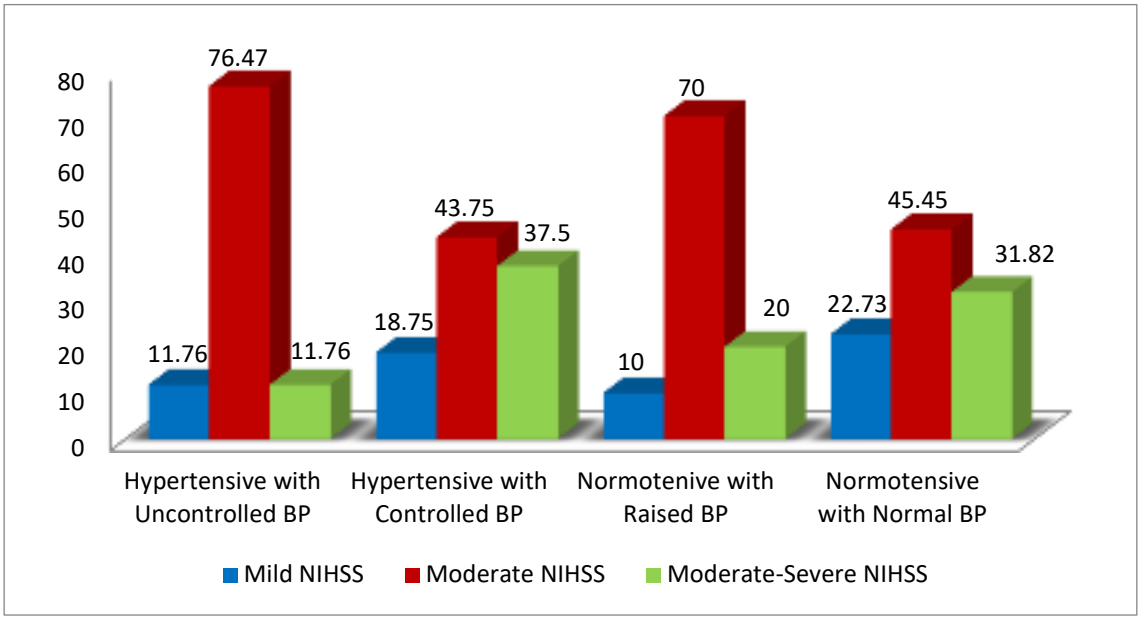


In our present study of 65 patients we did not find any relevant correlation between habits and NIHSS scoring system, P-value was statistically insignificant in all 65 patients with or without habits which is shown in the above table.

Table 27: Comparison of Hypertension with National Institute of Health Stroke Scale (NIHSS) severity

Hypertension	Blood pressure	Mild	%	Moderate	%	Moderate - severe	%	χ^2	p-value
Hypertensive	Uncontrolled BP	2	11.76	13	76.47	2	11.76	3.973	0.1370
	Controlled BP	3	18.75	7	43.75	6	37.5		
	Total	5	15.15	20	60.61	8	24.2		
Normotensive	Raised BP	1	10.00	7	70.00	2	20.0	1.71	0.424
	Normal BP	5	22.73	10	45.45	7	31.8		
	Total	6	18.75	17	53.13	9	28.1		

Figure 25: Comparison of Hypertension with NIHSS severity



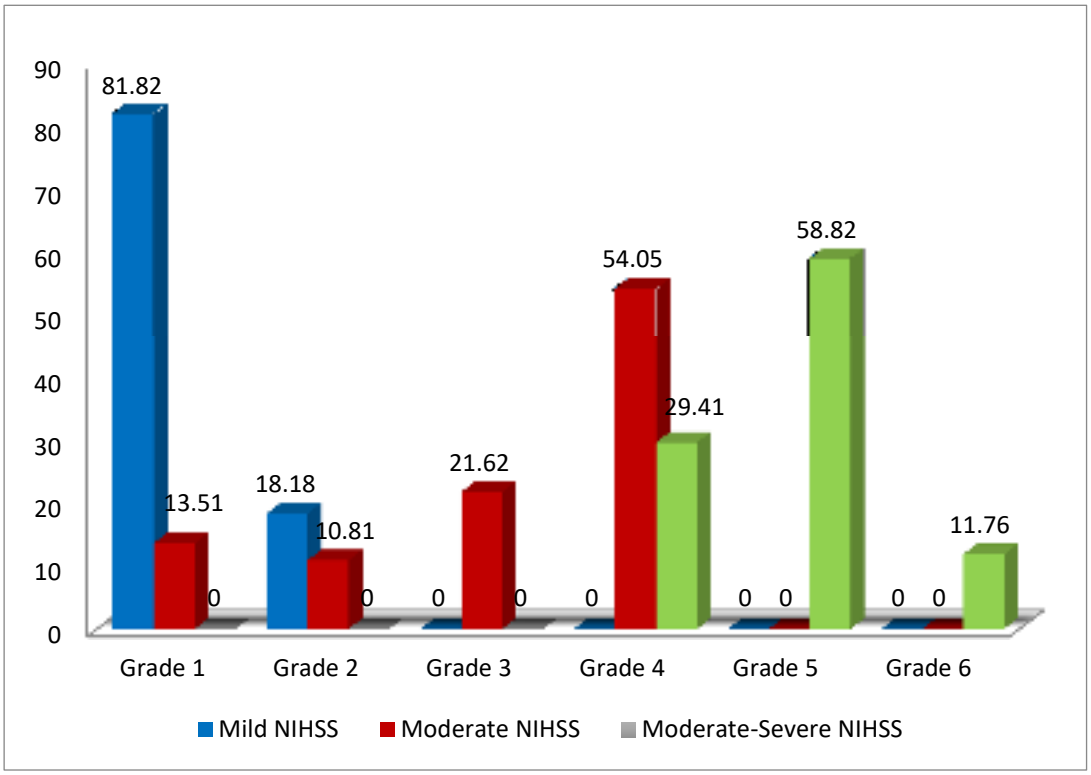
Comparison of NIHSS scoring with blood pressure did not show any correlation, P-value (0.1370) was statistically insignificant.

Table 28: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Modified Rankin Scale (MRS) grades

MRS grades	Mild	%	Moderate	%	Moderate - severe	%	Total	%	χ^2	p-value
Grade 1	9	81.82	5	13.51	0	0.00	14	21.54	72.818	0.0001*
Grade 2	2	18.18	4	10.81	0	0.00	6	9.23		
Grade 3	0	0.00	8	21.62	0	0.00	8	12.31		
Grade 4	0	0.00	20	54.05	5	29.41	25	38.46		
Grade 5	0	0.00	0	0.00	10	58.82	10	15.38		
Grade 6	0	0.00	0	0.00	2	11.76	2	3.08		
Total	**11**	**100.0**	**37**	**100.00**	**17**	**100.0**	**65**	**100.0**		

*$p<0.05$

Figure 26: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Modified Rankin Scale (MRS) grades



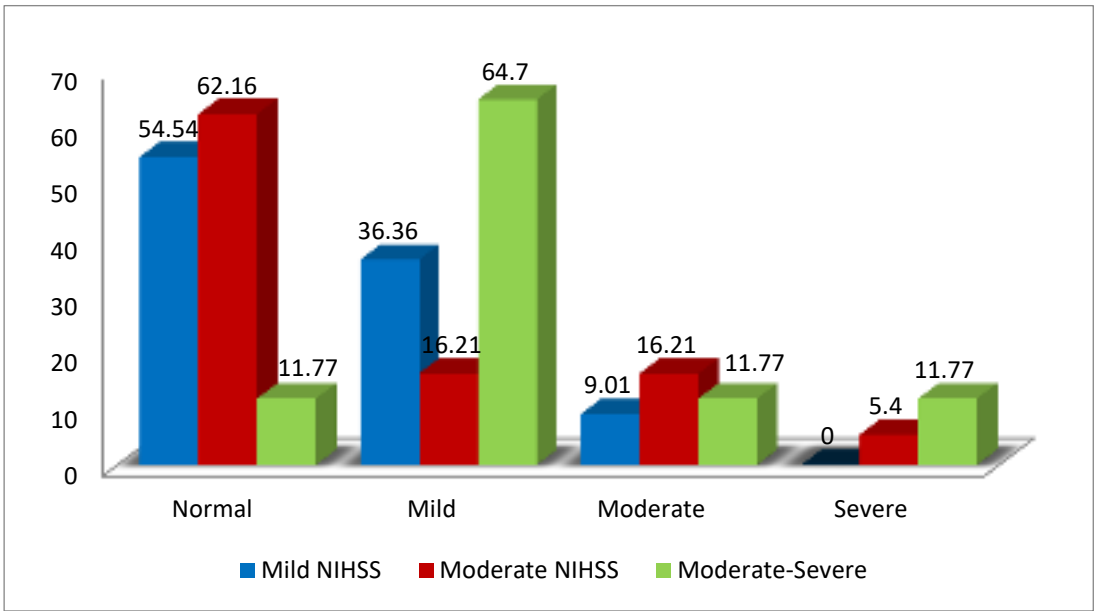
In our present study of 65 patients the comparison between both scoring systems (NIHSS and MRS) revealed positive correlation with the statistical value being significant (0.0001)

Table 29: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Serum Calcium levels

Calcium levels	Mild	%	Moderate	%	Moderate - severe	%	Total	%	χ^2	p-value
Normal	6	54.54	23	62.16	2	11.77	31	47.70	16.84	0.0098*
Mild	4	36.36	6	16.21	11	64.70	21	32.30		
Moderate	1	9.01	6	16.21	2	11.77	9	13.85		
Severe	0	0	2	5.40	2	11.77	4	6.15		
Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.0**	**65**	**100.0**		

*p<0.05

Figure 27: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Serum Calcium levels

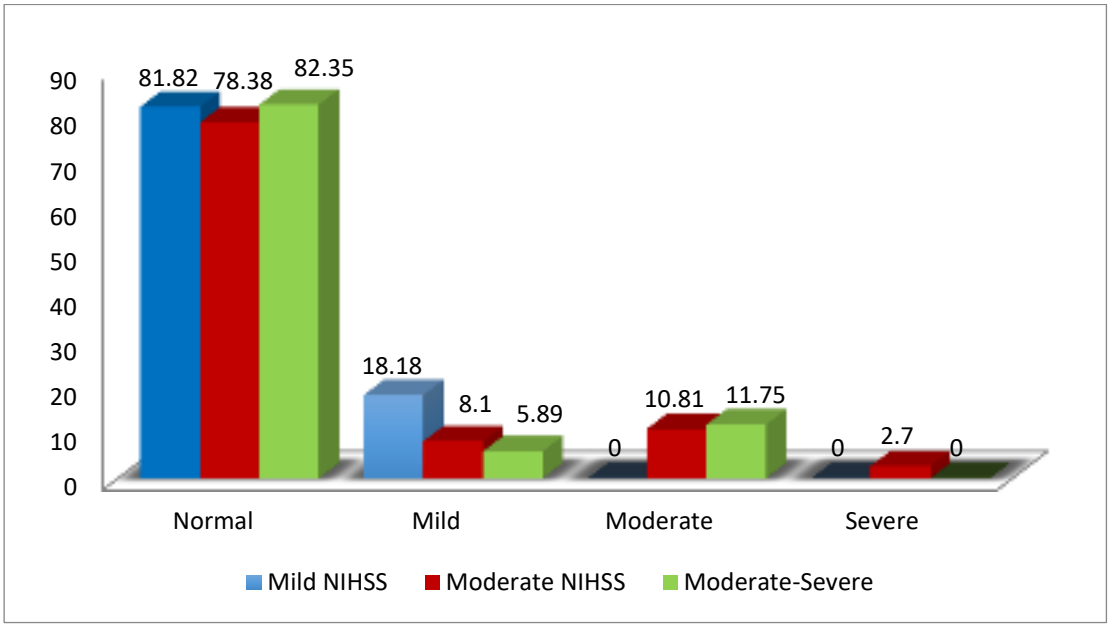


The levels of serum calcium were compared with NIHSS and the above observations were made. It did have a true reflection of serum calcium levels with the scoring system. P-value (0.0098) was statistically significant.

Table 30: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Serum Albumin levels

Albumin levels	Mild	%	Moderate	%	Moderate - severe	%	Total	%	χ^2	p-value
Normal	9	81.82	29	78.38	14	82.35	52	80.00	3.230	0.779
Mild	2	18.18	3	8.10	1	5.89	6	9.23		
Moderate	0	0.00	4	10.81	2	11.75	6	9.23		
Severe	0	0.00	1	2.70	0	0	1	1.54		
Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.00**	**65**	**100.00**		

Figure 28: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Serum Albumin levels

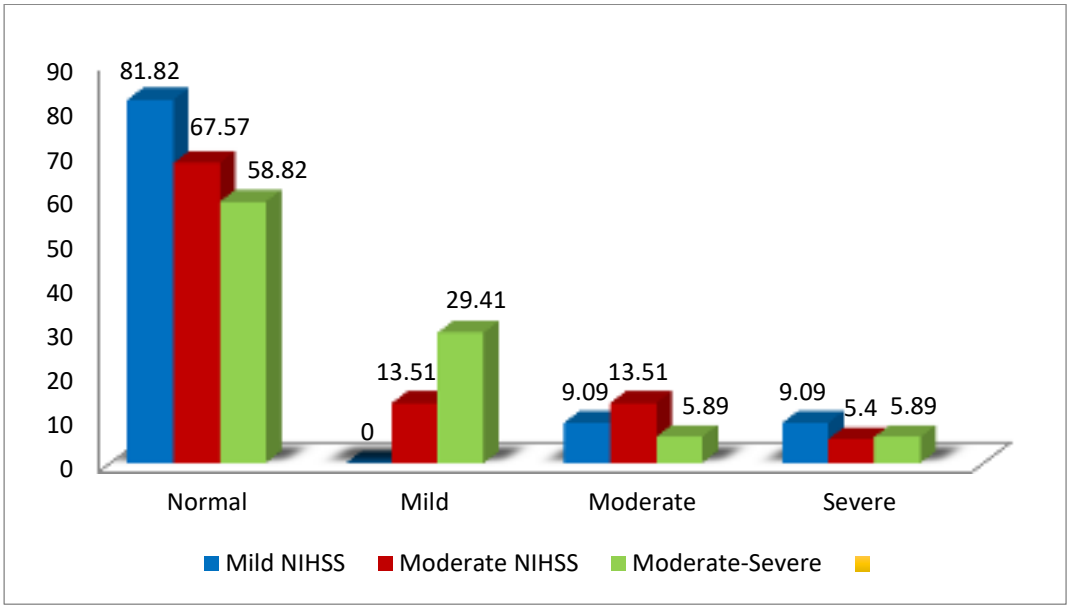


Similarly comparison of serum albumin levels with NIHSS severity was attempted and the observations were as shown in the above table. P-value (0.779) was statistically insignificant with the serum albumin levels.

Table 31: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Serum Uric acid levels

Uric acid levels	Mild	%	Moderate	%	Moderate - severe	%	Total	%	χ^2	p-value
Normal	9	81.82	25	67.57	10	58.82	44	67.70	5.327	0.5026
Mild	0	0.00	5	13.51	5	29.41	10	15.38		
Moderate	1	9.09	5	13.51	1	5.89	7	10.77		
Severe	1	9.09	2	5.40	1	5.89	4	6.15		
Total	**11**	**100.00**	**37**	**100.00**	**17**	**100.00**	**65**	**100.00**		

Figure 29: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Serum Uric acid levels

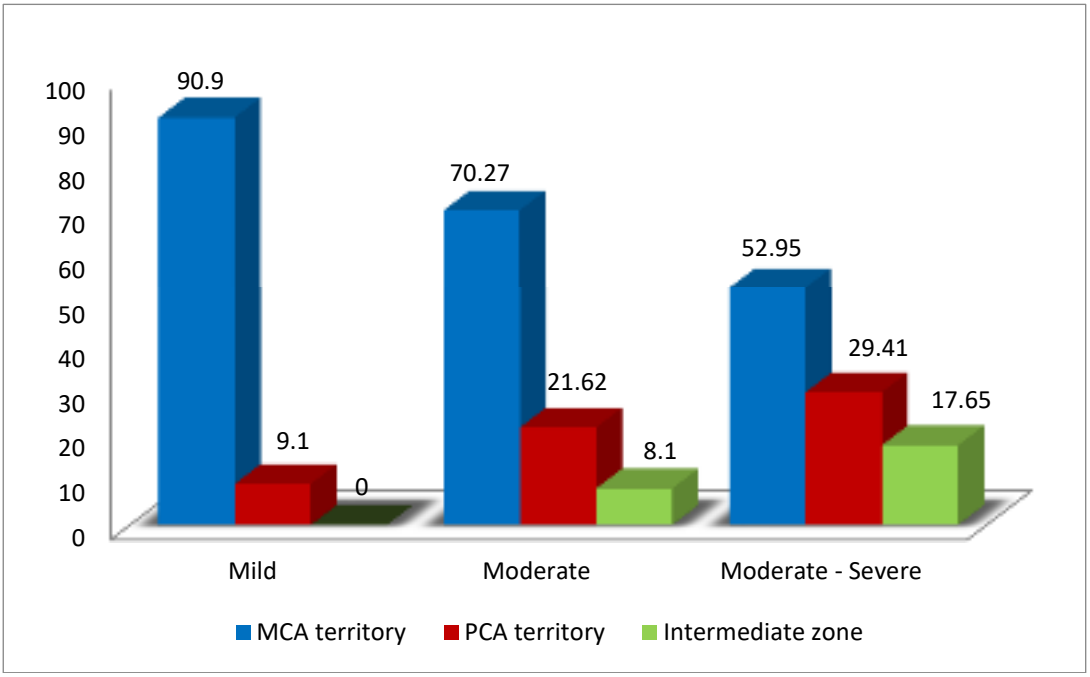


The third parameter Serum uric acid of patients was compared with NIHSS scoring system and was found to have no significant correlation between uric acid and the scoring system. P-value (0.5026) was statistically insignificant.

Table 32: Comparison of National Institute of Health Stroke Scale (NIHSS) severity with Neuro imaging

Neuro imaging	Mild	%	Moderate	%	Moderate - severe	%	Total	%	χ^2	p-value
MCA Territory	10	90.90	26	70.27	9	52.95	**45**	69.23	5.055	0.2816
PCA Territory	1	9.10	8	21.62	5	29.41	**14**	21.54		
Intermediate Zone	0	0	3	8.10	3	17.65	**6**	9.23		
TOTAL	**11**	**100.0**	**37**	**100.00**	**17**	**100.00**	**65**	**100.0**		

Figure 30: Comparison of NIHSS severity with Neuro imaging

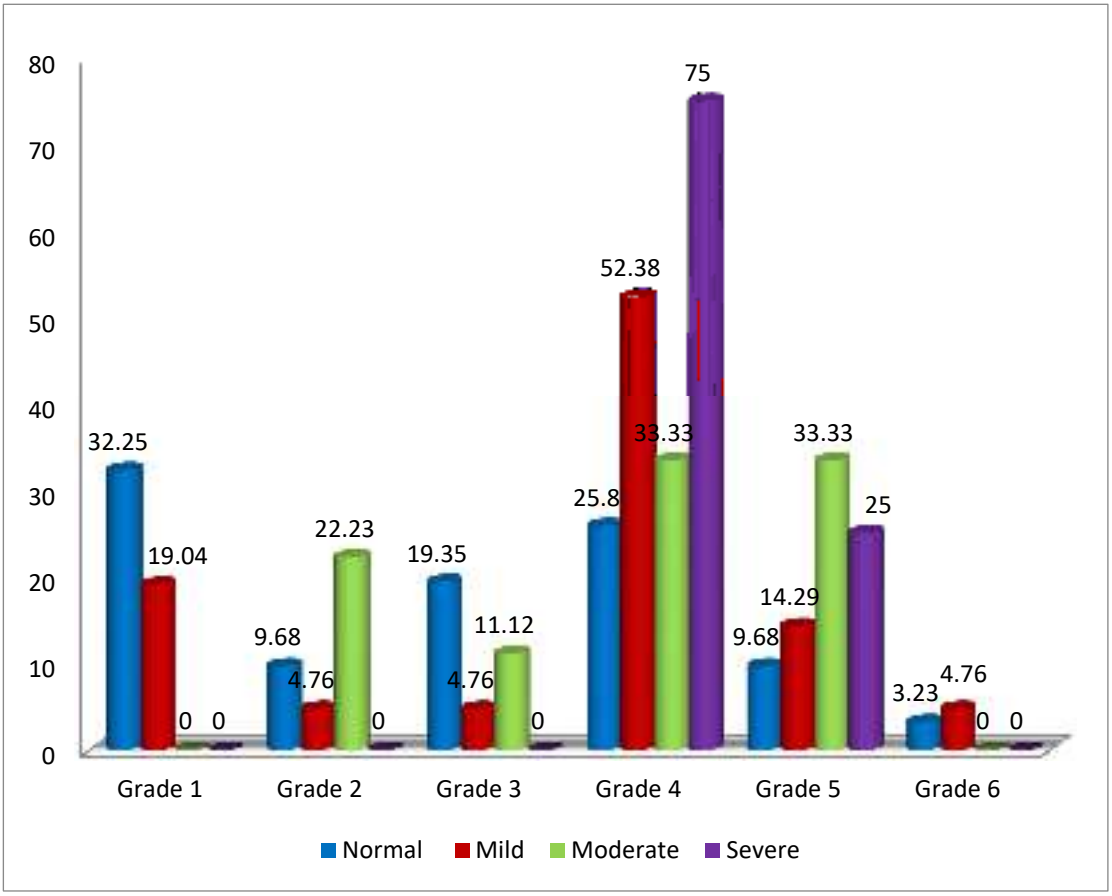


Similarly all patients imaging studies were compared with NIHSS and the observations made were not significant (P-value – 0.2816)

Table 33: Comparison of Modified Rankin Scale (MRS) grades at 1 week with Serum Calcium

MRS grades	Normal	%	Mild	%	Moderate	%	Severe	%	Total	%
Grade 1	10	32.25	4	19.04	0	0	0	0	14	21.54
Grade 2	3	9.68	1	4.76	2	22.23	0	0	6	9.23
Grade 3	6	19.35	1	4.76	1	11.12	0	0	8	12.30
Grade 4	8	25.80	11	52.38	3	33.33	3	75	25	38.46
Grade 5	3	9.68	3	14.29	3	33.33	1	25	10	15.39
Grade 6	1	3.23	1	4.76	0	0	0	0	2	3.07
Total	**31**	**100.00**	**21**	**100.00**	**9**	**100.0**	**4**	**100.0**	**65**	**100.00**
Chi-square= 16.908 p= 0.3244										

Figure 31: Comparison of Modified Rankin Scale (MRS) grades at 1 week with Serum Calcium

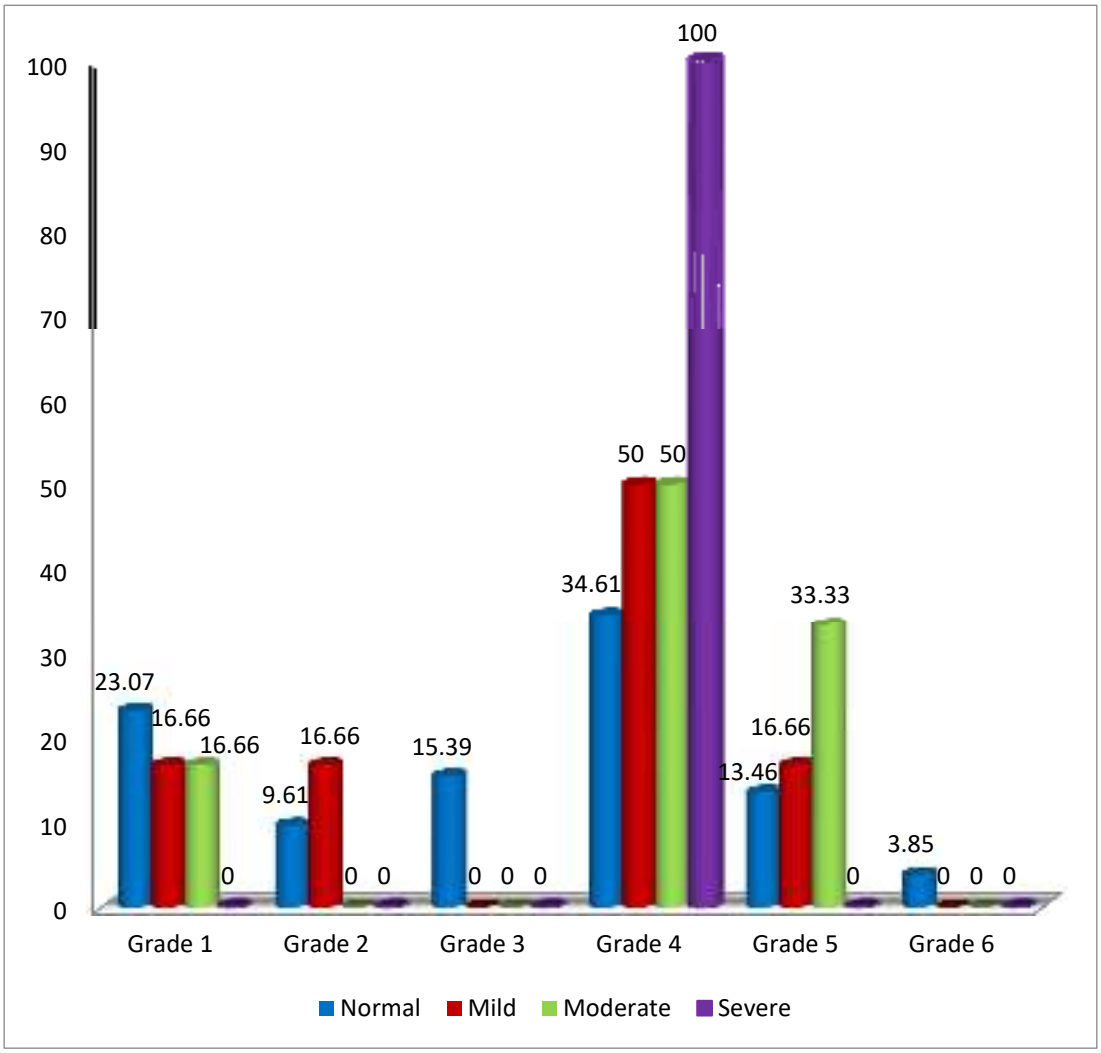


The levels of serum calcium were compared with outcome measuring scale (MRS) at the end of 1 week and the observations made are depicted in the above table. P-value was statistically insignificant (0.3244)

Table 34: Comparison of Modified Rankin Scale (MRS) grades at 1 week with Serum Albumin

MRS grades	Normal	%	Mild	%	Moderate	%	Severe	%	Total	%
Grade 1	12	23.07	1	16.66	1	16.66	0	0	14	21.54
Grade 2	5	9.61	1	16.66	0	0	0	0	6	9.23
Grade 3	8	15.39	0	0	0	0	0	0	8	12.30
Grade 4	18	34.61	3	50	3	50	1	100	25	38.46
Grade 5	7	13.46	1	16.66	2	33.33	0	0	10	15.39
Grade 6	2	3.85	0	0	0	0	0	0	2	3.07
Total	**52**	**100.00**	**6**	**100.00**	**6**	**100.00**	**1**	**100.00**	**65**	**100.00**
Chi-square= 7.060, p= 0.956										

Figure 32: Comparison of Modified Rankin Scale (MRS) grades at 1 week with Serum Albumin

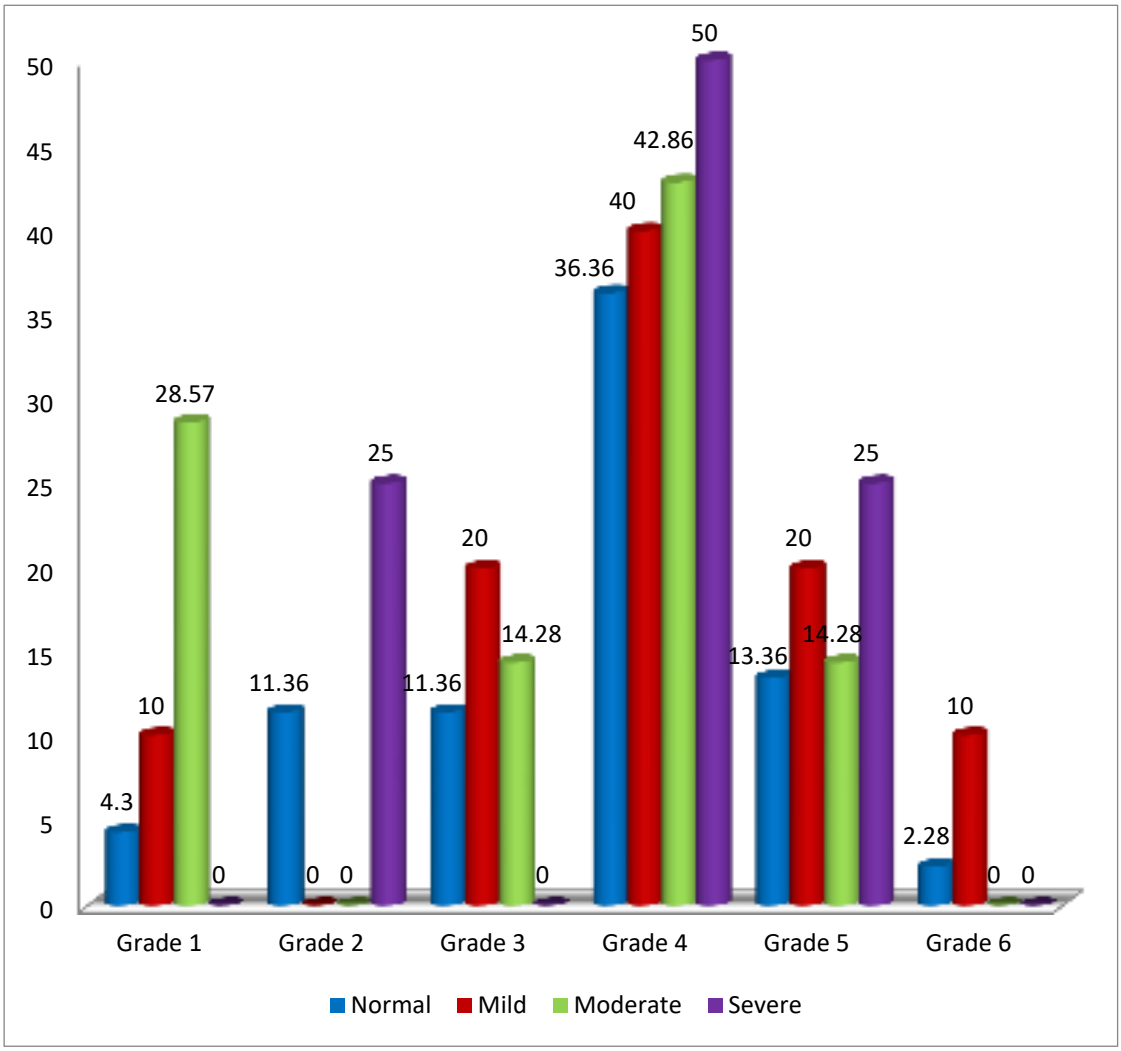


Similarly the above observations were made when MRS grades were compared with serum albumin. P-value was statistically insignificant (0.956)

Table 35: Comparison of Modified Rankin Scale (MRS) grades at 1 week with Serum Uric acid

MRS grades	Normal	%	Mild	%	Moderate	%	Severe	%	Total	%
Grade 1	11	25	1	10	2	28.57	0	0	14	21.54
Grade 2	5	11.36	0	0	0	0	1	25	6	9.23
Grade 3	5	11.36	2	20	1	14.28	0	0	8	12.30
Grade 4	16	36.36	4	40	3	42.86	2	50	25	38.46
Grade 5	6	13.36	2	20	1	14.28	1	25	10	15.39
Grade 6	1	2.28	1	10	0	0	0	0	2	3.07
Total	**44**	**100.00**	**10**	**100.00**	**7**	**100.00**	**4**	**100.00**	**65**	**100.00**
Chi-square= 8.466, p= 0.903										

Figure 33: Comparison of Modified Rankin Scale (MRS) grades at 1 week with Serum Uric acid



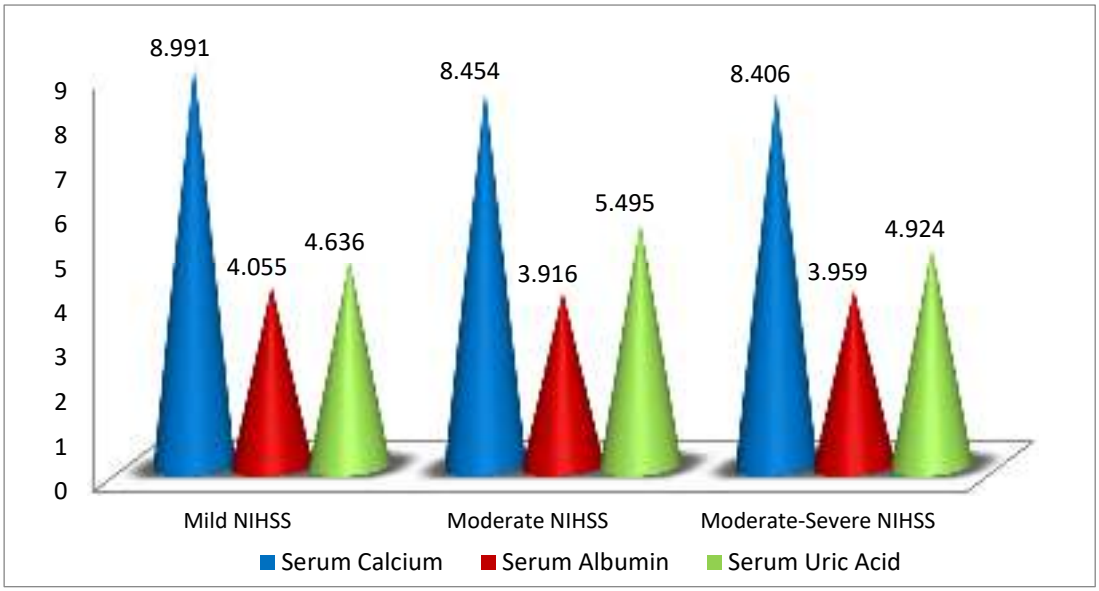
The comparison of serum uric acid levels with MRS grades was also made, and the observations are shown in the above table. P-value was statistically insignificant (0.903)

Table 36: Comparison of NIHSS severity with Serum Calcium (mg/dl), Serum Albumin (g/dl) and Serum Uric Acid (mg/dl) by one way ANOVA

NIHSS severity	Serum Calcium (mg/dl)		Serum Albumin (g/dl)		S. Uric acid (mg/dl)	
	Mean	SD	Mean	SD	Mean	SD
Mild	8.991	0.550	4.055	0.466	4.636	2.188
Moderate	8.454	0.588	3.916	0.680	5.495	2.311
Moderate to Severe	8.406	0.618	3.959	0.520	4.924	1.922
Total	**8.532**	**0.617**	**3.951**	**0.603**	**5.200**	**2.191**
F-value	4.0409		0.2194		0.8294	
P-value	0.0224*		0.8036		0.4411	

*p<0.05

Figure 34: Comparison of NIHSS severity with Serum Calcium (mg/dl), Serum Albumin (g/dl) and Serum Uric Acid (mg/dl) by one way ANOVA

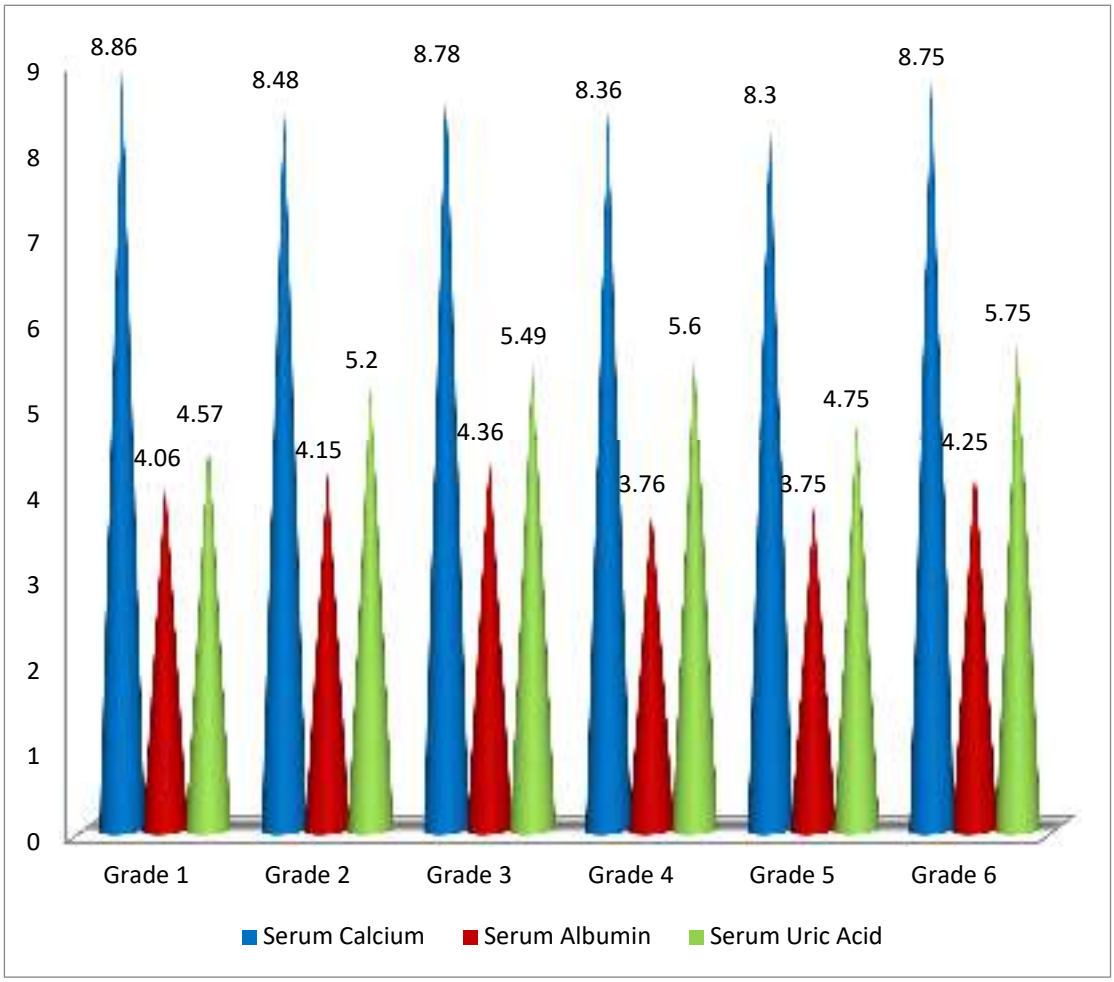


When all the three lab parameters are compared with NIHSS severity by one way ANOVA method, serum calcium alone reflected a significant low level in patients of acute ischemic stroke and P-value was statistically significant (0.0224).

Table 37: Comparison of MRS grades with Serum Calcium (mg/dl), Serum Albumin (g/dl) and Serum Uric acid (mg/dl) by one way ANOVA

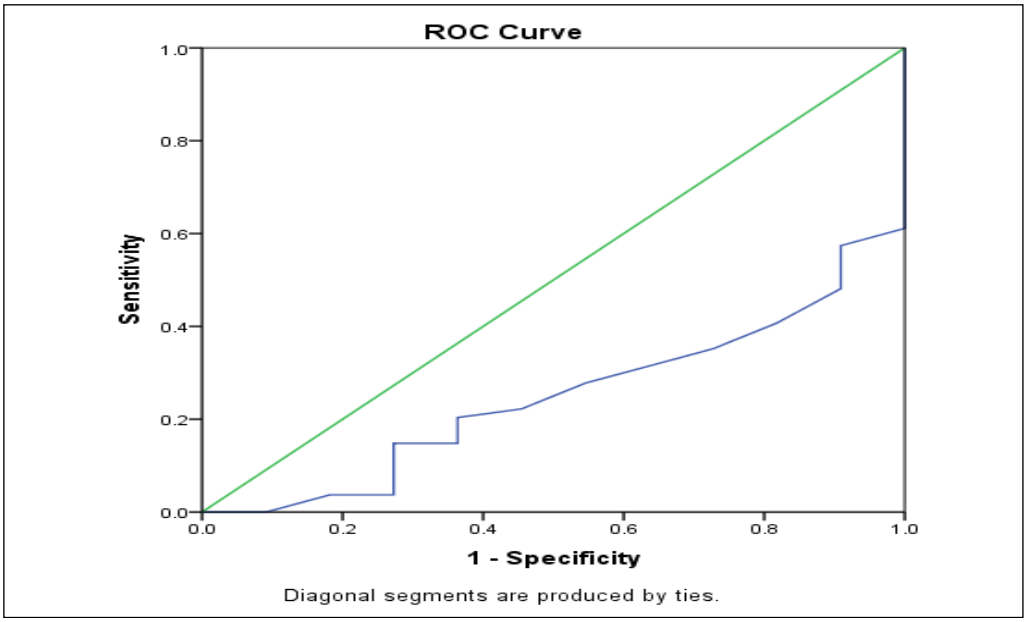
MRS grades	Serum Calcium (mg/dl)		Serum Albumin (g/dl)		Uric acid (mg/dl)	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Grade 1	8.86	0.55	4.06	0.46	4.57	1.92
Grade 2	8.48	0.48	4.15	0.56	5.20	1.95
Grade 3	8.78	0.58	4.36	0.35	5.49	1.68
Grade 4	8.36	0.64	3.76	0.71	5.60	2.58
Grade 5	8.30	0.56	3.75	0.53	4.75	2.29
Grade 6	8.75	0.78	4.25	0.49	5.75	0.64
Total	**8.53**	**0.62**	**3.95**	**0.60**	**5.20**	**2.19**
F-value	1.9383		1.8981		0.5106	
P-value	0.1015		0.1083		0.7671	

Figure 35: Comparison of MRS grades with Serum Calcium (mg/dl), Serum Albumin (g/dl) and Serum Uric acid (mg/dl) by one way ANOVA



Attempting to compare all the three lab parameters using one way ANOVA method with MRS grading did not reflect any significant values. P-value was statistically insignificant in all the three lab parameters; Serum Calcium (0.1015), Serum Albumin (0.1083) & Uric acid (0.7671).

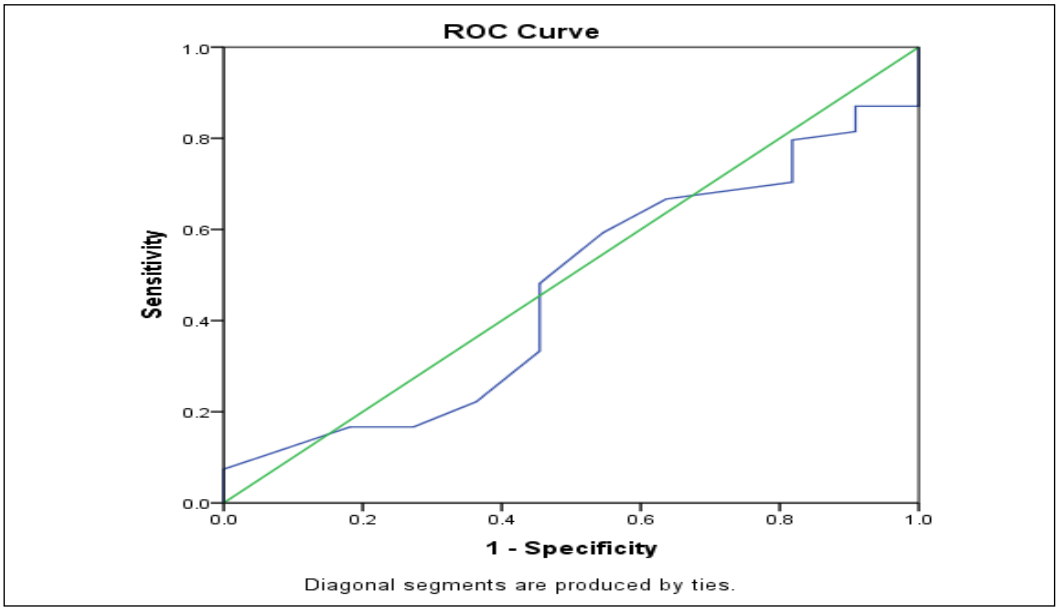
Table 38 (Figure 1): Receiver Operating Characteristics (ROC) curve of Serum Calcium (mg/dl) as compared with National Institute Health Stroke Scale



Area Under the Curve				
Test Result Variable(s): Serum Calcium (mg/dl)				
Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.247	.068	.008	.114	.380
a. Under the nonparametric assumption				
b. Null hypothesis: true area = 0.5				

In our present study on plotting ROC curve for calcium at arrival, we observed area under the curve to be 0.247. It failed to have validated prediction in predicting favourable outcome as far as stroke was concerned.

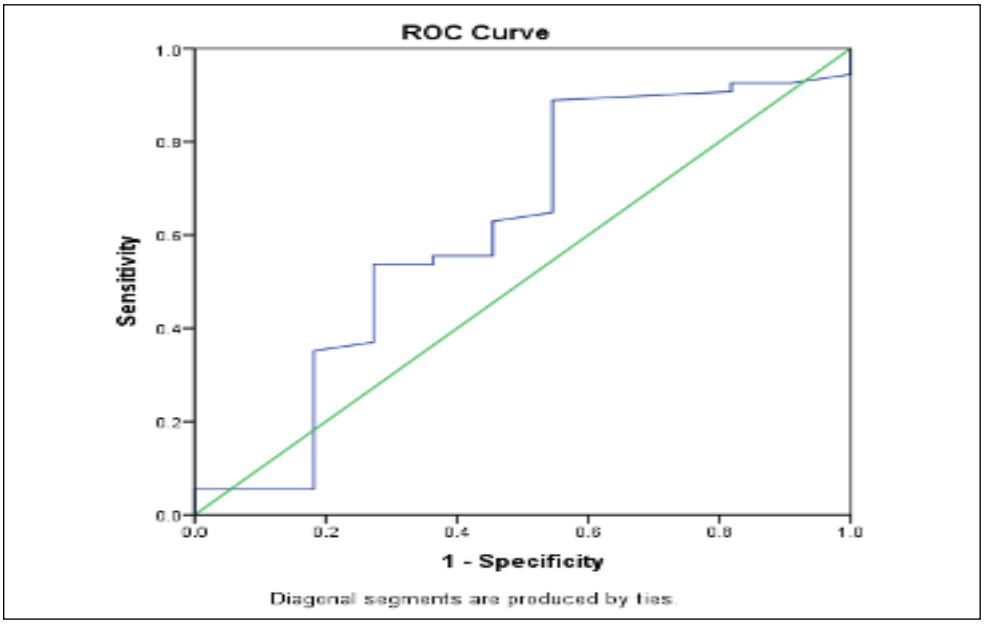
Table 38 (Figure 2): Receiver Operating Characteristics (ROC) curve of Serum Albumin (g/dl) as compared with National Institute Health Stroke Scale



Area Under the Curve				
Test Result Variable(s): Serum Albumin (g/dl)				
Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.463	.094	.700	.278	.647
a. Under the nonparametric assumption				
b. Null hypothesis: true area = 0.5				

Similarly the area under the curve in ROC curve for albumin levels was 0.463. It did not reflect a favourable prediction in patients with acute ischemic stroke.

Table 38 (Figure 3): Receiver Operating Characteristics (ROC) curve of Serum Uric acid (mg/dl) as compared with National Institute Health Stroke Scale



Area Under the Curve				
Test Result Variable(s): Serum Uric acid (mg/dl)				
Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.614	.103	.234	.412	.817
a. Under the nonparametric assumption				
b. Null hypothesis: true area = 0.5				

The area under the curve was 0.614 for serum uric acid in the above ROC curve. Again there was no true validation in outcome of patients with serum uric acid.

DISCUSSION

In our present study, maximum number of patient were in the age group of 51 to 65 years, 19 in the age group of 66 to 80 years, 11 in the age group of 36 to 50 years and five each in the age group of 21 to 35 years and ≥ 81 years respectively. The youngest patient was 22 years old, who was a cocaine addict and the oldest patient was 89 years old. The mean age was 59.98 ± 15.44 years. The study done by Dr Sivasubramaniyam et al.[74] have compared all the three parameters (Serum Calcium, Serum Albumin and Serum Uric acid) found maximum number of cases between the ages of 55 to 64 years (N=18); 45 to 54 years age group had 15 patients and 12 patients were in the age group of 65 to 74 years. A study by Reeta James et al.[80] have also compared serum albumin as parameter in their hundred stroke patients, but not compared other two parameters (Serum calcium and serum uric acid); found maximum number of cases between 40 to 60 years (N=43) and 36 patients in 60 to 80 years of age.

In our study of 65 patients, 45 patients (69.23 %) were males and remaining 20 patients (30.78%) were females. The male preponderance was noted with the ratio of male: female = 2.25:1. A study by Dr Sivasubramaniyam et al.[74] have compared all the three parameters in the study population, but they have not segregated their patients as male and female. A study by Reeta James et al.[80] have compared only one parameter (serum albumin) and found slight male preponderance (N=54, 54%) to female (N=46, 46%). A study by Adel Hamed Elbaih et al.[1] who have studied serum albumin in their patients, had more female patients N=35 (58.30%) as compared to male patients N=25 (41.70%).

The various clinical presentation of 65 patients revealed; 52 patients (80%) with limb weakness, 50 patients (76.92%) with difficulty in speech, cranial nerve involvement in 34 patients (52.31%), altered consciousness in 29 patients (44.62%), ataxia in 12 patients (18.46%), and sensory dysfunction in 4 patients (6.15%). Only one author Dr.Sivasubramaniyam et al.[74] have done all the three parameters; but have not done the distinction between age, sex and clinical presentation. A study by Adel Hamed Elbaih et al.[1] in 60 patients found that, 55% of them had weakness of both upper and lower limbs, 45% patients noted speech disturbances and 45% had altered consciousness. Going through various studies, the comparison of age, sex and clinical presentation was not done and even many studies have done research only on single parameter that is serum calcium, serum albumin or serum uric acid at the time of presentation.

Examination of all 65 patients revealed, 54 patients (83.08%) had motor deficit, 50 patients (76.92%) had speech disturbances, 34 patients (52.31%) had cranial nerve palsy, 30 patients (46.15%) had altered sensorium, 13 patients (20%) had cerebellar dysfunction and 4 patients (6.15%) had sensory deficit. A study by Adel Hamed Elbaih et al.[1] have quoted the clinical presentation of the patients in their study population, but they have not commented on the clinical signs at presentation. Going through other studies no one has commented on the clinical signs at the time of presentation in their study group.

In our study of 65 patients we observed hypertension as the most common comorbidity N= 17 (26.15%), followed by diabetes N= 6 (9.23%), coronary artery disease N= 5 (7.69%), overlapping comorbidities 19 (29.23%) and 18 patients (27.69%) did not have any comorbidities at the time of presentation. This is in sharp

contrast to a study by Reeta James et al.[80] in their study group various comorbidities were noted and hypertension was the most common comorbidity (N= 34 patients) followed by dyslipidemia (N= 16 patients). Most of their patients had more than one comorbidities (hypertension + diabetes in 14 patients, hypertension + dyslipidemia in 05 patients, diabetes + dyslipidemia in 05 patients) and only 09 patients did not have any comorbidity. A study by Adel Hamed Elbaih et al.[1] observed hypertension and diabetes together in 55% of their patients and remaining 45% did not have any comorbidity. They also observed past history of cardiovascular disease like ischemic heart disease and atrial fibrillation in their study population. The comorbidities observed were overlapping comorbidities and they have not segregated hypertension or diabetes separately in their study population.

In our study we observed 10 patients (15.38%) with habit of smoking, 07 patients (10.77%) had history of chewing tobacco and 06 patients (9.23%) with history of alcohol consumption. Overlapping of these habits was observed in 13 patients (20%) and 29 patients (44.62%) did not have any habits. Reeta James et al.[80] observed smoking and tobacco chewing together in 35 patients, alcohol alone in 10 patients; alcohol with tobacco chewing in 3 patients and 52 patients did not have any habits in their study.

In our present study, we had 33 patients (50.77%) with hypertension, of which 17 (26.15%) had uncontrolled blood pressure and 16 (24.60%) had controlled blood pressure at the time of presentation. Remaining 32 patients (49.23%) were normotensive; however 10 patients (15.38%) among them had raised blood pressure at presentation. The minimum and maximum systolic blood pressure in our study is 90 mmHg & 200 mmHg, with mean systolic blood pressure of 138.06 mmHg.

Similarly minimum and maximum diastolic blood pressure is 60 mmHg and 110 mmHg, with mean diastolic blood pressure of 82.36 mmHg. Jong-Won Chung et al.[76] and Reeta James et al.[80] observed hypertension in their study population and gave importance to systolic blood pressure of > 140 mmHg and diastolic blood pressure > 90 mmHg. Categorization as hypertensive, non-hypertensive or normotensive with raised blood pressure at presentation was not done by these authors.

We attempted to subdivide patients based on National Institute of Health Stroke Scale (NIHSS) severity as mild, moderate, moderate-severe and severe. The results observed were 11 patients (16.92%) with mild severity, 37 patients (56.92%) with moderate severity and moderate-severe in 17 patients (26.15%). A similar study to ours wherein all the three parameters were taken into consideration (Serum Calcium, Serum Albumin and Serum Uric acid) for validation of patients with stroke by Dr.Sivasubramaniyam et al.[74] the comparison of their patients with NIHSS scoring scale revealed mild to moderate (<10 NIHSS severity) in 44 patients and moderate to severe (>10 NIHSS severity) in 56 patients. They have not categorized their patients as mild, moderate and moderate-severe in their study population. They have divided into only 2 categories as mild-moderate and moderate-severe NIHSS severity. A study by Abha Gupta et al.[75] who have taken only serum calcium as a lab parameter in their study population; when they compared their patients with NIHSS scoring, found 15 patients (30%) in mild category, 19 patients (38%) in moderate, 6 patients (12%) in moderate-severe and 10 patients (20%) in severe category.

We tried to categorize our patients based on modified Rankin scale (MRS) grading at 1 week and results obtained were maximum number of patients 25 (38.46%) were in grade 4, followed by 14 (21.54%) in grade 1, 10 (15.38%) in grade

5, 08 (12.31%) in grade 3, 06 (9.23%) in grade 2 and only 02 patients (3%) in grade 6. Abha Gupta et al.[75] in their study have compared the patients with MRS grades and found 12 patients in grade 2 (24%), 11 patients (22%) in grade 4, 10 patients (20%) in grade 1, 09 patients (18%) in grade 5, 05 patients (10%) in grade 6 and only 03 patients (6%) in grade 3.

LAB PARAMETERS

All our patients were subjected to serum calcium level estimation and found, 31 patients (47.69%) with normal serum calcium levels (8.6 - 10.2 mg/dl), remaining 34 patients (52.31%) had levels below normal range (≤ 8.5 mg/dl). Further categorization of serum calcium levels as mild, moderate and severe revealed 21 patients (32.30 %) in mild category (8.1-8.5 mg/dl), moderate (7.6-8.0 mg/dl) in 09 patients (13.85%) and severe (≤ 7.5 mg/dl) in 04 patients. A similar study by Dr.Sivasubramaniyam et al.[74] who have compared all the three parameters (Serum Calcium, Serum Albumin & Serum Uric acid) in their patients have found the levels of serum calcium in normal range in 40 patients (40%) and remaining 60 patients (60%) had low levels of calcium (≤ 8.6 mg/dl). They have not categorized based on severity of calcium levels as mild, moderate and severe. Another study by Abha Gupta et al.[75] have found in their study of 50 patients; 25 patients (50%) had levels within normal limit and equal number of patients below 8.5 mg/dl.

A study by Jong-won Chung et al.[76] in their large study of patients with stroke have taken albumin corrected calcium levels. Probable explanation for this would be that, the true reflection of serum calcium levels alone without taking into consideration the albumin corrected calcium because half of the serum calcium is bound to serum proteins particularly serum albumin. As a result change in serum

protein causes the change in the total serum calcium without affecting the physiological and clinically important ionized calcium. Thus adjustment of total serum calcium to serum albumin is a better parameter for evaluation of serum calcium at cellular levels, when directly measured. The underlying biological mechanism responsible for poor short term outcome and mortality associated with elevated albumin corrected calcium levels is now being established.

According to another school of thought and few experimental models the influx of calcium into neuronal cells is a mechanism of ischemic cell death. Glutamate stimulated calcium influx into the cultured neurons by calcium and elevated calcium levels with N-Methyl D-Aspartate receptor (NMDA) stimulation has been observed using fluorescent probes. Further it was noted that inhibitors of effectors of calcium toxicity such as calmodulin, calcineurin or neuronal nitric oxide synthase (NO) protects the neurons against the toxic effects of amino acids. These studies suggest that elevated albumin corrected calcium levels cause neuronal death. Further mitochondrial dysfunction also contributes to delayed neuronal death, which has been established decades ago. Massive calcium accumulation triggers the direct mitochondrial damage and the mitochondria exposed to calcium swells up releasing its content. Apart from this, the oxidative stress along with the accumulated calcium in the mitochondria, activate its permeability transition leading to depolarization coupled production of reactive oxygen species. This explains the association of calcium level with a poor neurological outcome in stroke.

All patients were subjected to serum albumin estimation and found to have normal level (3.6-5.2 g/dl) in 52 patients (80%). Remaining 13 patients (20%) had low levels of albumin (≤3.5 g/dl). Further we categorized serum albumin deficiency

as mild (3.1-3.5 g/dl), seen in 06 patients (9.23%), moderate (2.6-3 g/dl) in 06 patients (9.23%) and severe in only 1 patient (1.54%). Adel Hamed Elbaih et al.[1] found in their study population of 60 patients, 44 (73.34%) had albumin levels between 3.5-5 g/dl and 16 patients (26.66%) had below 3.5 g/dl which is almost consistent with our study. A study by Dr.Sivasubramaniyam et al.[74] have also found in their study group of 100 patients, the albumin levels of ≥ 3.5 g/dl in 44 patients (44%) and below 3.5 g/dl in 56 patients (56%).

It is a known fact that albumin is neuro-protective agent by binding to lysophosphatidyl choline. Free lysophosphatidyl choline increases leucocyte adhesion molecules which lead to inflammatory mediated damage to vascular endothelium and may likewise cause apoptosis in higher concentration. With the above properties of albumin (beneficial effects) it may be used as an infusion in patients with hypoalbuminemia, which may help in better outcome of patients with ischemic stroke. Albumin has got a scavenging property which may further help to reduce the production of oxygen free radicals. Albumin binds to copper ions by which it may inhibit the process of lipid peroxidation that is depending on copper ion at the cellular levels.

Serum uric acid estimation in all 65 patients revealed 44 patients (67.69%) had levels below 5.7 mg/dl and remaining 21 patients (32.30%) had levels above 5.7 mg/dl. Further we attempted to categorize our patients as mild (5.8-7.2 mg/dl), moderate (7.3-8.5 mg/dl), and severe (≥ 8.6 mg/dl); which had 10 patients (15.38%), 07 patients (10.76%) and 04 patients (6.15%) respectively. A study by Dr.Sivasubramaniyam et al.[74] have found normal levels of uric acid in 45 patients (45%) and elevated levels in 55 patients (55%). A study by Payam Saadat et al.[82] have

found in their population, 57% had normal levels of serum uric acid, 25% had low levels and remaining 18% had higher levels of serum uric acid.

The explanation for elevated levels of serum uric acid in patients of stroke is proposed that; the neurons of brain when subjected to hypoxia or ischemia have increased expression of xanthine oxidase, the rate limiting enzyme in conversion of hypoxanthine to xanthine and xanthine to uric acid. Xanthine oxidase is the only enzyme that helps in metabolizing xanthine and uric acid in human beings. In other mammals Urate Oxidase metabolizes the uric acid to allantoin, a potent antioxidant. This enzymatic activity is not seen because of possibility of uric acid as the compensatory mechanism in primates, who cannot produce other potent antioxidants. As a result of xanthine oxidase activity, uric acid generation is supposed to be a more potent response to ischemia of neurons in humans. So it represents as a marker of tissue infarction. However the limitation does exist. The estimation of serum uric acid as a result of focal ischemia may not be a true reflection; as we measure peripheral blood for uric acid estimation. We also feel it is necessary to do serial estimation of serum uric acid levels in patients of stroke, rather than once estimation at arrival of patients; which may not reflect as a parameter of stroke severity.

All our 65 patients were randomly assigned depending on the need basis to either CT/MRI imaging. 20 patients (30.76%) were subjected to CT Brain study and remaining 45 patients (69.23%) to MRI Brain study. Some patients were further evaluated by MRI angiogram as necessity warranted for the sake of completion of the study. The findings of CT/MRI brain are depicted in table 18. A study by Dr.Sivasubramaniyam et al.[74] in their series of 100 patients; subjected their patients to neuroimaging. Plain CT Brain was done and MRI brain was done whenever required.

Similarly a study by Reeta James et al.[80] also subjected all their patients to CT Brain alone to rule out haemorrhagic stroke or any obvious mass lesion. They found 53 patients (53%) with MCA infarct, 25 patients (25%) with lacunar infarct, 17 patients (17%) had multi infarcts and 05 (5%) had PCA stroke. Another study by Santni Manickam et al.[81] found more number of cases in MCA territory (N=30, 60%) and other areas included multi infarcts (N=9, 18%), PCA territory (N=5, 10%) and lacunar infarcts (N=6, 12%). In our study we had a total of 45 (69.23%) MCA territory infarcts, 14 (21.54%) PCA territory infarcts and 6 (9.23%) intermediate zone infarcts. Both the studies quoted above and ours have revealed maximum number of cases in MCA territory.

We attempted to compare National Institute of Health Stroke scale (NIHSS) with age in our study population and found no significant correlation. P-value was statistically insignificant (0.190). Most of the studies having gone through have not compared NIHSS scoring with age, sex and clinical presentation (symptoms & signs); whereas we did the comparison with age (P-value = 0.190) and sex (P-value = 0.753) and found no correlation with statistically insignificant P-value.

However we did find correlation of clinical presentation with National Institute of Health Stroke Scale in patients presenting with these clinical symptoms at the time of arrival; Limb weakness (P-value = 0.00014), Speech Difficulty (P-value = 0.0012) and Cranial nerve involvement (P-value = 0.00028).

There was correlation between clinical signs and National Institute of Health Stroke scale in our present study, in patients presenting with Motor Deficit (P-value = 0.00059), Speech Disturbances (P-value = 0.0012), Cranial nerve palsy (P-value = 0.0028) and Altered Sensorium (P-value = 0.00193). These findings had significant

correlation and P-value was statistically significant. Going through studies by different workers (authors) they have not compared clinical signs of their patients with NIHSS scoring like our present study.

We attempted to compare comorbidities with National Institute of Health Stroke Scale severity and found no significant correlation in patients with comorbidities (Hypertension, Diabetes, Coronary artery disease or overlapping habits). P-value was statistically insignificant (0.2702). A study by Santni Manickam et al.[81] found patients with comorbidities (Hypertension, Diabetes) had increased risk of stroke in their study population. They also found stroke was common in patients with increasing age, though their patients were in the middle age group. The risk of stroke was also observed more in males than females. A study by Abha Gupta et al.[75] also found, comparison of comorbidities had significant increased risk of stroke and statistically significant correlation. They also found correlation between NIHSS and age of the patient.

Similarly we compared habits of the patient with National Institute of Health Stroke Scale. There was no significant correlation with habits of the patients (Smoking, Tobacco Chewing and Alcohol or Overlapping habits). P-value was statistically insignificant (P-value = 0.420). Most of the studies have not compared habits with NIHSS severity. A study by Reeta James et al.[80] have found in their study the risk of smoking as a modifiable risk factor to prevent risk of stroke.

We also compared our hypertensive patients with National Institute of health Stroke Scale severity. Those hypertensives either controlled/uncontrolled or normotensives with raised blood pressure at presentation did not have any bearing with the scoring system (Table 25). P-value was statistically insignificant in

hypertensives (0.137) and normotensive patients (0.424). Abha Gupta et al.[75] have found correlation between NIHSS severity with their hypertensive patients. Another study by Reeta James et al.[80] have found correlation between hypertension and stroke.

We tried to compare the two systems of stroke that is National Institute of health Stroke Scale (NIHSS) and modified Rankin Scale (MRS). Both the scales were statistically significant in validation of patients with stroke as shown in table 26, P-value was 0.0001. A study by Abha Gupta et al.[75] have done the comparison of both the scoring systems and found that the outcome was not favourable in patients with higher grading in MRS scale or patients with moderate or moderate-severe category in NIHSS scale; which is almost consistent with our study. Another study by Santni Manickam et al.[81] have also drawn similar conclusion in their study. Patients who had higher NIHSS category also had higher MRS grades and poor outcome.

Comparison of serum calcium with NIHSS severity in our study found low levels of serum calcium had poor outcome compared with NIHSS severity score and P-value was statistically significant (0.0098). We observed in our study 04 patients who had severe depletion of calcium (< 7.5 mg/dl) had poor outcome (MRS grade 4 & 5). It has been observed that the calcium ion plays a very important pathophysiological role in cerebral ischemia. It has been noted that the levels of calcium are decreased in patients with stroke. The gross brain damage leading to oedema of the brain and infarction enhanced by tissue acidosis leads to neuronal damage in a focalized way. The disturbed calcium homeostasis may trigger further lipolysis and proteolysis.

It has been observed that the normal levels of serum calcium or higher levels at the time of stroke had a small infarct in patients with ischemic stroke. Some authors

have studied the levels at the time of presentation and levels after admission did not have a significant difference in early and delayed calcium levels. In our earlier discussion (Jong-won Chung et al[76]) we have stated the beneficial effects of calcium in patients of stroke. A study by Dr.Sivasubramaniyam et al.[74] have also found the role of serum calcium in ischemic stroke patients that the low levels of serum calcium are associated with either bigger infarct or poor outcome. Another study by Abha Gupta et al.[75] also draws the same conclusion that the severity of stroke is more at low calcium levels than higher levels and also functional outcome gets better as serum calcium levels increase.

Similarly we tried to compare serum albumin levels and NIHSS severity scale. The findings observed were either in the mild group of reduced albumin levels or in the moderate group or in the moderate-severe group. They did not have any bearing with the NIHSS severity scale. P-value was statistically insignificant (0.779). A study by Santni Manickam et al.[81] in their study group, have compared serum albumin levels with NIHSS at arrival and serum albumin levels with MRS grading alone at discharge and after 3 months of discharge; they did not find any correlation between the serum albumin levels and the scoring system. P-value was statistically insignificant in their study also. A study by Dr.Sivasubramaniyam et al.[74] found in their study population, a significant correlation of serum albumin levels with NIHSS scoring and also found serum albumin levels > 3.5 g/dl had a better outcome.

A study by Idicula et al.[74] studied a large number of patients (N=444) with ischemic stroke. The outcome of these patients was prognosticated by NIHSS and MRS scale and found the result as, how serum albumin was independently associated with better outcome and good prognosis. The P-value was statistically significant.

They further concluded that, the higher serum albumin levels might be neuroprotective in ischemic stroke in human beings. Similarly a study by Sharma et al.[74] (Delhi) compared serum albumin levels with NIHSS and Barthel index to prognosticate the outcome. They found the levels of serum albumin negatively correlated with the NIHSS severity scores and positively correlated with the Barthel index. Dziedzic et al.[74] studied 759 consecutive patients with acute ischemic stroke and functional outcome was measured using MRS scale, which showed a significant correlation with poor outcome in patients with low serum albumin levels. In our study we have not used Barthel index. The beneficial effects of serum albumin levels in ischemic stroke, is covered in our earlier discussion.

Comparison between serum uric acid levels and all the three groups that is mild, moderate and moderate-severe of NIHSS score did not reflect any significant correlation between them. The P-value was statistically not significant (0.5026). Erwin Chiquete et al.[83] did not find the lower levels of serum uric acid, when NIHSS score was 09. But when score was below 05, they did find the lower levels of serum uric acid. Other confounding variables for low serum uric acid levels would be female gender, younger age and normal creatinine levels. Further at admission they did not find a favourable short term outcome and poor short term outcome in patients with lower levels and higher levels of serum uric acid respectively. In our earlier discussion we have stated the role of serum uric acid in outcome of patients with acute ischemic stroke.

We also attempted to compare neuroimaging with NIHSS severity and the results obtained did not have any influence as far as the vascular territory was concerned. P-value was statistically insignificant (0.2816, Table 30). To best of our

knowledge going through different authors and their studies, they have not compared the NIHSS scoring system with the neuroimaging findings.

We further attempted in our 65 patients comparing all the three lab parameters (Serum Calcium, Serum Albumin and Serum Uric acid) with modified Rankin scale and found no significant correlation as far as our study was concerned (P- values of Serum Calcium = 0.3244, Serum Albumin = 0.956 and Serum Uric acid = 0.903). This is in sharp contrast to a study by Abha Gupta et al.[75] who have compared only serum calcium levels and found that the severity of stroke is more with the lower levels of serum calcium than the higher levels. They also found that the functional outcome was better as calcium levels go up. A study by Dr.Sivasubramaniyam et al.[74] who have compared all the three lab parameters in their study have found positive correlation of higher calcium levels, higher albumin levels and low uric acid levels in their study population with NIHSS and MRS scoring system.

Further all the three lab parameters (Serum Calcium, Serum Albumin and Serum Uric acid) were compared by one way ANOVA method with NIHSS severity and we found the significant low serum calcium levels in patients of acute ischemic stroke. Same was compared with NIHSS scores individually but only serum calcium reflected low levels in our study population, with statistically significant P-value of 0.0224. Whereas serum albumin and uric acid did not show any influence in our patients. Among the studies which we have quoted in our discussion, no author has deployed this method of analysis in their patients. Most of the authors have taken only single parameter. A study by Dr.Sivasubramaniyam et al.[74] who have taken all the three lab parameters and found low serum calcium levels in their study population, but has not used the one way ANOVA method for analysing their patients.

In our study all the three lab parameters were compared with modified Rankin scale grading and did not have any significant values noted in all 65 patients. Even by taking these parameters by one way ANOVA analysis and comparing with MRS grading did not reflect any positive correlation.

Finally we attempted to compare serum calcium, serum albumin and serum uric acid by plotting ROC curve at arrival. The area under the curve for serum calcium, albumin and uric acid was 0.247, 0.463, and 0.614 respectively. From charting of ROC curve with the area under the curve revealed no validated prediction in outcome of patients with acute ischemic stroke in our study. Most of the authors have not plotted ROC curve in their study.

We feel it is worthwhile in taking large sample size in acute ischemic stroke and comparing the same with various variables like age, sex, comorbidities, habits, clinical presentation, clinical signs and lab parameters to see whether these factors have got any bearing in neurological status either to prognosticate or to see for functional worsening. A simple tool like estimation of serum calcium, serum albumin and serum uric acid is available in even smaller setting when used to prognosticate these patients, which may help the treating physician to look for outcome of these patients. We did not find any positive correlation with all these variables except patients' presentation and clinical signs. We found significant low levels of serum calcium in our study population when compared with NIHSS severity which is consistent with most of the studies.

In our present study of 65 patients, the main short coming we feel was the small sample size. Other factors also could have influenced on these parameters like nutritional status, built of the patient and hydration status which we have not taken

into consideration at the time of study. As for calcium level is concerned we have done total calcium level estimation, but ideally ionized serum calcium level is more relevant because it is physiologically active component of serum calcium. However we did find the correlation of serum calcium levels with stroke when compared with NIHSS severity. When serum albumin was taken into account, majority of our patients (N=52) had normal serum albumin levels. Probably it has not reflected any positive reflection in our study. Similarly serum uric acid levels may be influenced by hydration of the patient at the time of presentation, built and gender (low levels are noted in female gender). All these factors were not taken into account while estimating serum uric acid levels in our study. It is also noted that the size of infarct may increase the serum uric acid levels, by mechanism which has already been explained in our earlier discussion.

CONCLUSION

In our present study of 65 patients with acute ischemic stroke, we observed a significant correlation between serum calcium levels (low levels) and NIHSS severity scale. However there was no correlation between serum albumin and serum uric acid levels comparing with NIHSS. Based on these findings of our study, the prominent features are mentioned below.

- Maximum patients of stroke at presentation were in 5^{th} to 8^{th} decade (49 patients)
- We observed more number of male patients as compared to females; however we did not draw any conclusion on gender having influence over stroke and its outcome.
- The commonest clinical presentations were limb weakness, difficulty in speech, cranial nerve involvement and altered consciousness.
- Physical signs observed were motor deficits, speech disturbances, cranial nerve palsy and altered sensorium. We found correlation of clinical presentation and signs when compared with National Institute of Health Stroke Scale (NIHSS).
- Hypertension was observed in 17 patients followed by overlapping comorbidities in 19 patients and 18 patients did not have any comorbidity.
- The comorbidities did not have any bearing on outcome in our study population.
- 36 patients had one or the other habits (Smoking, Tobacco chewing, Alcohol consumption or overlapping habits). Even habits did not have any bearing on the severity of stroke and outcome of patients.

- Comparing the different lab parameters (Serum Calcium, Serum Albumin and Serum Uric acid) with NIHSS, except for serum calcium which showed a positive correlation for low levels in our study, other two parameters did not show any significant correlation.
- These three lab parameters were compared with Modified Rankin Scale (MRS) which did not show any correlation.
- By neuroimaging studies the vascular territory involved in these patients were identified. They also had no positive correlation with the NIHSS scoring system; though more number of patients were in MCA territory group.
- Finally we conclude saying that; to overcome bias like small sample size, age, gender, comorbidities, habits, albumin corrected calcium levels, ionized calcium level estimation, built and nutritional status would have been taken into consideration to prognosticate and to see the functional outcome of patients with acute ischemic stroke.

SUMMARY

- ✓ The present study was undertaken on 65 patients presenting with Acute Ischemic Stroke to KLE's Dr Prabhakar Kore Hospital and Medical Research Centre, Belagavi during the period of January 2020 to December 2020.
- ✓ In the present study of 65 patients various demographic factors, comorbidities, habits, clinical presentation with signs, lab parameters and neuroimaging were compared with National Institute of Health Stroke Scale severity score and lab parameters alone with Modified Rankin Scale grading.
- ✓ Stroke was common in the age group of 5^{th} to 8^{th} decade. Male patients were 45 (69.23%) and female patients were 20 (30.77%). Male preponderance was seen with the ratio of 2.25:1. Hypertension was seen in 17 patients (26.15%), overlapping comorbidities were observed in 19 patients (29.23%), Diabetes in 06 patients (9.23%), Coronary artery disease in 05 (7.69%) and no comorbidities in 18 patients (27.69%). Hypertension and Diabetes did not show any significant correlation on outcome in our present study. Lab parameters like serum calcium, serum albumin and serum uric acid when compared with NIHSS scoring; the positive correlation was seen only with low serum calcium levels. Other two parameters (serum albumin and uric acid) did not show any positive correlation with National Institute of Health Stroke Scale severity. Similarly comparing all the three parameters with Modified Rankin Scale did not show any positive correlation.

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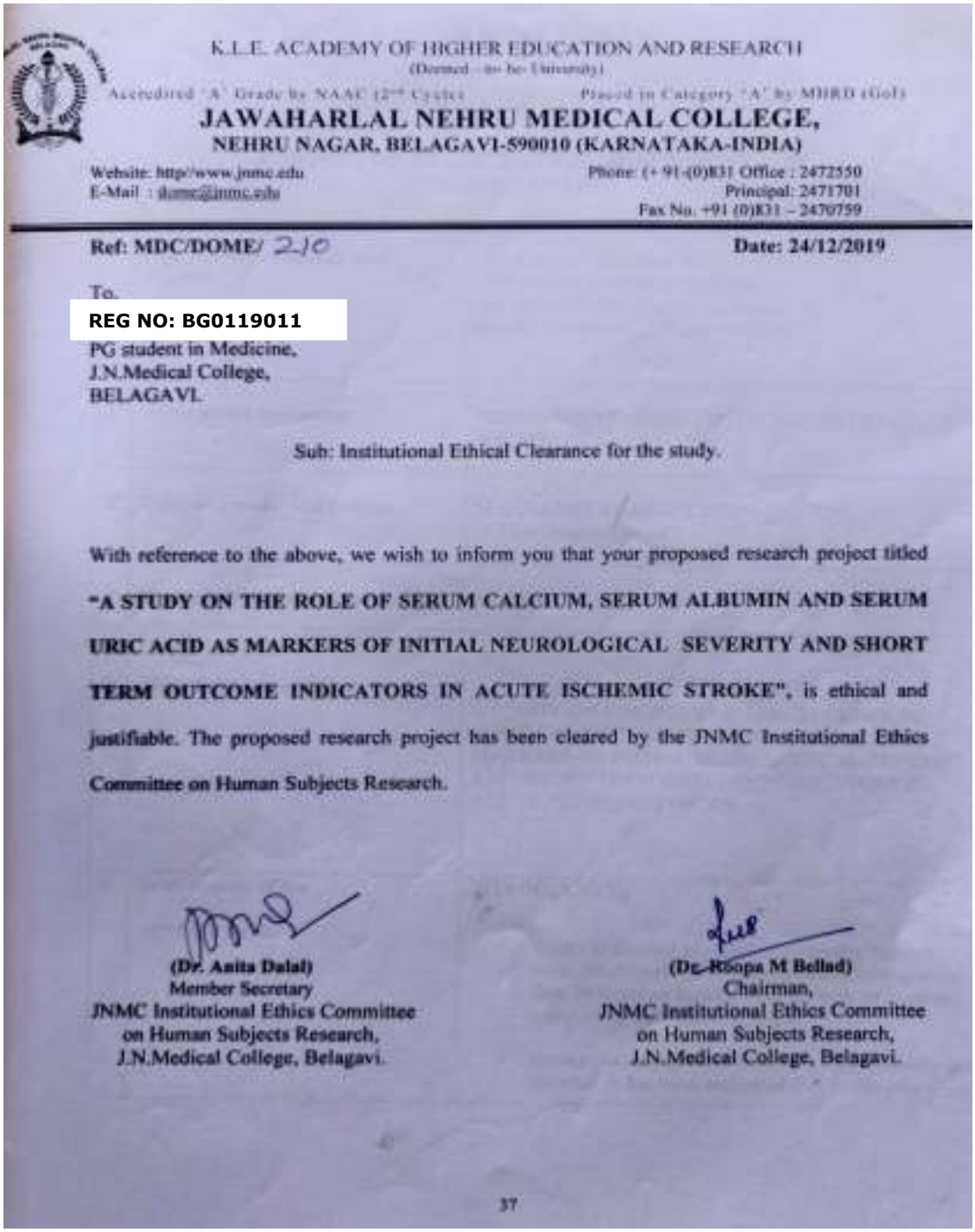
ANNEXURES

ANNEXURE - I

ETHICAL CLEARANCE CERTIFICATE



K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed - to-be- University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)

JAWAHARLAL NEHRU MEDICAL COLLEGE,
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Ref: MDC/DOME/ 210 **Date: 24/12/2019**

To,

REG NO: BG0119011

PG student in Medicine,
J.N.Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"A STUDY ON THE ROLE OF SERUM CALCIUM, SERUM ALBUMIN AND SERUM URIC ACID AS MARKERS OF INITIAL NEUROLOGICAL SEVERITY AND SHORT TERM OUTCOME INDICATORS IN ACUTE ISCHEMIC STROKE"**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr. Anita Dalal)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

(Dr. Roopa M Belludi)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

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ANNEXURE – II - CONSENT FORM

Title Of Research Study: A STUDY ON THE ROLE OF SERUM CALCIUM, SERUM ALBUMIN AND SERUM URIC ACID AS MARKERS OF INITIAL NEUROLOGICAL SEVERITY AND SHORT TERM OUTCOME INDICATORS IN ACUTE ISCHEMIC STROKE.

Principal Investigator -

_____

Post Graduate Student,

Department Of General Medicine,

JNMC, Belagavi.

Guide -

_____

Professor and Unit Head,

Department of General Medicine,

JNMC, Belagavi.

Introduction and Purpose:

Stroke is a global health problem and a leading cause of long term disability. Where stroke mortality rates are declining or stabilizing in developed countries, experts are concerned of the emerging stroke epidemic in India. As life expectancy is projected to increase, India will likely face a significant socioeconomic burden to meet the costs of managing stroke.

Procedure:

If you agree to be part of the research study, you will be asked the relevant history and will be subjected to relevant clinical examination and investigations. You will also have to give blood and urine samples for the necessary investigations.

Risk and Benefits:

The only risk and possible discomfort you might get is while taking blood from your arm for the investigations. It may cause swelling, pain, redness (rarely happens) at the site from where the blood is drawn.You may not be benefitted by these investigations but you will be part of this study which is going to be useful to others in the future.

Alternatives:

Taking part in this study is voluntary. You may choose not to take part in this study. If you decide to take part you can later change your mind and withdraw from the study. Your decision will not change the present or future health care or other services that you receive. The study doctor or sponsor may stop your participation in this study at any time. If you choose not to take part in the study, you will receive the standard treatment for patients with your condition.

Privacy and Confidentiality:

All information collected about you during the course of this study will be kept confidential to the extent permitted by law. The code numbers will identify you in this research record. Information from this study may be published but your identity will be confidential in any publication.

Institution / Sponsor's policy:

Does not apply to this research

Financial incentives for participation:

You will not be paid / offered any gifts /incentives for participating in the study.

Authorization to publish the results:

The results of the study would be forwarded to the KLE University, Belagavi as part of requirement towards the completion of MD degree, review and publishing.

In case of the queries during study or in future you may contact following persons,

1) Dr. Roopa Bellad, Chairman, JNMC Ethical Committee for Human Research.

CONSENT FORM

Title Of Research Study: **A STUDY ON THE ROLE OF SERUM CALCIUM, SERUM ALBUMIN AND SERUM URIC ACID AS MARKERS OF INITIAL NEUROLOGICAL SEVERITY AND SHORT TERM OUTCOME INDICATORS IN ACUTE ISCHEMIC STROKE.**

I voluntarily agree to take part in this study by signing below. I may withdraw at any time. I am not giving up any of my legal rights by signing this form. My signature below indicates that I have read this consent form, or it has been read to me and has been explained to me in my vernacular language and all my questions have been answered. I will be given a copy of this consent form.

Signature / Left Thumb print of the Participant or legally authorized representative

Participant's name :……...

Signature / Left thumb impression :……...

of the participant

Name of the legally authorized :……...

representative / guardian

Signature / Left thumb impression :……...

Witness' name :……...

Signature / Left thumb impression :……...

Investigator's name and signature :……...

Date:

Place:

ANNEXURE - III

PROFORMA

CASE NO: **DATE:**

IP NO.:

NAME:

AGE/SEX:

OCCUPATION:

ADDRESS:

PHONE NO:

DOA: **DOD:**

COMPLAINTS AT PRESENTATION:

H/O MOTOR WEAKNESS:

H/O SENSORY SYMPTOMS:

H/O CRANIAL NERVE INVOLVEMENT:

H/O SPEECH DISTURBANCES:

H/O BOWEL AND BLADDER DISTURBANCES:

H/O SEIZURES:

H/O LOSS OF CONSCIOUSNES

H/O HEAD INJURY

PAST HISTORY:

H/O Diabetes Mellitus: Yes/No

H/O Hypertension: Yes/No

H/O Ischemic Heart Disease: Yes/No

H/O Tuberculosis: Yes/No

H/O Epilepsy: Yes/No

H/O Hepatobiliary disease: Yes/No

H/O Hemolytic Anemias : Yes/ No

PERSONAL HISTORY:

HABITS:

Alcohol: Yes/No

Smoking: Yes/No

GENERAL PHYSICAL EXAMINATION

Pulse Rate:

Blood Pressure:

SYSTEMIC EXAMINATION:

Central Nervous System:

Higher Mental Functions:

Cranial Nerves:

Motor System:

Sensory System:

Reflexes:

Cerebellar signs:

Signs of meningeal irritation:

Skull and Spine:

Cardiovascular System:

Respiratory System:

Per Abdomen:

NIHSS SCORE AT ADMISSION:

1) Level of Consciousness

2) Horizontal Eye Movement

3) Visual Field Test

4) Facial Palsy

5) Motor - Arm

6) Motor - Leg

7) Limb Ataxia

8) Sensory

9) Language

10) Speech

11) Extinction and Inattention

MODIFIED RANKIN SCORE AT END OF 1 WEEK:

CT/MRI REPORT AT ADMISSION:

INVESTIGATIONS:

Serum Calcium levels: mg/dL

Serum Albumin levels: g/dL

Serum Uric acid levels: mg/dL

RBS: mg/dL

Complete Blood Picture:

Hemoglobin (g/dL)	
P.C.V (%)	
RBC Count (million/mm^3)	
Platelet Count (/mm^3)	
TLC (/mm^3)	
DLC (N/L/E/M/B) (%)	

Liver Function Tests:

Total Bilirubin (mg/dL)	
Direct Bilirubin (mg/dL)	
Indirect Bilirubin (mg/dL)	
SGOT (U/L)	
SGPT (U/L)	
Alkaline Phosphatase (U/L)	
Total Proteins (g/dL)	
A:G Ratio	

Renal Function Tests:

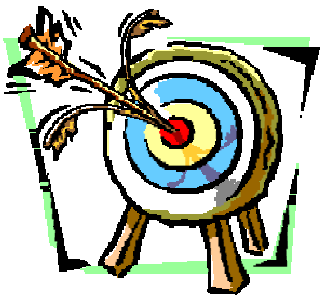
Blood Urea (mg/dL)	
Serum Creatinine (mg/dL)	
Sodium (mmol/L)	
Potassium (mmol/L)	
Bicarbonate (mmol/L)	
Chlorides (mmol/L)	

ANNEXURE – IV MASTER CHART

S.No	IP NUMBER	NAME	AGE	SEX	CLINICAL PRESENTATION						CLINICAL SIGNS						COMORBIDITIES	HABITS	BP(mmHg)	NIHSS AT ADMN	NIHSS SEVERITY	MRS AT 1 WEEK	INVESTIGATIONS			NEUROIMAGING
					Limb weakness	Difficulty in Speech	Cranial Nerve Involvement	Altered consciousness	Ataxia	Sensory Dysfunction	Motor deficit	Speech Disturbances	Cranial Nerve Palsy	Altered Sensorium	Cerebellar Dysfunction	Sensory Deficit							S.CALCIUM (mg/dL)	S.ALBUMIN (g/dL)	S.URIC ACID (mg/dL)	CT (20)/MRI (45)
1	1012033	NAMADEV MAJAGOAKAR	48	M	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	C	B	90/70	12	Moderate	4	8.7	3.9	5	A
2	1016440	CHALANA GANDOSHI	56	F	yes	yes	yes	no	yes	no	yes	yes	yes	no	yes	no	D	E	150/80	13	Moderate	4	9	4.8	6.9	B
3	1016611	JOONABI SHABASHKHAN	70	F	yes	yes	yes	yes	no	no	yes	no	yes	yes	no	no	A	E	160/100	20	Moderate to Severe	5	8	4	3	A
4	1023890	KIRAN KAMBLE	40	M	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	A	A	140/90	10	Moderate	3	9.8	4.9	8.2	A
5	1030498	MALLIKARJUN KATAKOL	70	M	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	E	C	130/80	9	Moderate	3	8.6	4.3	3.9	C
6	1030642	GANGAVVA TALLUR	59	F	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	D	E	170/100	15	Moderate	4	9	3.7	4.1	A
7	1034717	MOHAN GHODAKE	37	M	yes	yes	yes	no	yes	no	yes	yes	yes	no	yes	no	E	C	140/90	8	Moderate	2	9.2	4.4	3.3	B
8	1034590	ANANT MUNNOLI	59	M	yes	yes	no	no	no	no	yes	yes	no	no	no	no	D	E	148/94	1	Mild	1	9.5	4.5	3	C
9	1036856	VIMAL KOKITKAR	56	F	yes	no	no	no	no	no	yes	no	no	no	no	no	A	E	150/90	4	Mild	1	9.1	3.9	3	A
10	1038467	SAIDAPPA GADAGI	62	M	yes	yes	no	no	no	no	yes	yes	no	no	no	no	B	E	142/80	5	Moderate	1	8.6	4.2	8.2	A
11	1039491	BASAPPA YALAIGOL	65	M	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	A	A	170/60	7	Moderate	1	8.2	4.3	4.3	A
12	1040172	DURGAPPA CHOUGULE	61	M	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	A	D	160/90	14	Moderate	4	8.4	4	3.4	C
13	1041404	RAMEZA MUJAWAR	64	F	no	yes	yes	yes	no	no	no	yes	yes	yes	no	no	A	E	160/90	10	Moderate	4	8.2	3.3	4.8	B
14	1041155	KALAWA REVADIGAR	84	F	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	A	E	110/60	7	Moderate	3	8.8	4.3	5.6	A
15	1040929	RATHNAKAR KURATI	60	M	yes	no	no	no	yes	no	yes	no	no	no	yes	no	B	A	140/90	6	Moderate	1	8.4	3	4.6	A
16	1040578	SHAKUNTALADEVI AGARWAL	68	F	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	A	E	180/110	15	Moderate	4	9.2	4	5.1	A
17	1035072	SURESH ARAGI	38	M	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	E	D	130/70	16	Moderate to Severe	4	8.1	4.2	5.8	A
18	1041876	DHURBA DAS	72	M	yes	yes	no	yes	no	yes	yes	yes	no	yes	no	yes	E	B	184/100	5	Moderate	2	8	3.8	5.6	A
19	1042116	DEEPAK SAHO	30	M	yes	no	no	no	no	no	yes	no	no	no	no	no	E	D	200/100	6	Moderate	1	8.4	4.4	3.4	A
20	1042358	APOLIN FERNANDES	80	M	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	D	C	140/60	13	Moderate	4	8.1	2.7	5.3	C
21	1041066	SUSHILA ARBINWADI	65	F	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	E	E	180/100	13	Moderate	4	8.7	4.3	1.7	A
22	1041799	NARENDRA JADEJA	81	M	yes	yes	no	yes	no	no	yes	yes	no	yes	no	no	A	C	150/90	12	Moderate	4	7.3	1.9	6.4	A
23	1042831	CHINTAMANI MURAGUDE	75	M	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	A	E	130/90	12	Moderate	3	9	4.3	6.7	A

24	1043122	AJJAPPA BEERANOLLI	60	M	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	E	D	90/70	14	Moderate	4	7.4	2.6	10.6	A
25	1042435	MALLAPPA KAMATE	45	M	no	no	no	no	yes	no	yes	no	no	no	yes	no	A	A	130/90	5	Moderate	3	8.7	4.6	2.6	B
26	1042419	ASHOK MUTAGEKAR	67	M	yes	yes	no	no	no	no	yes	yes	no	no	no	no	D	D	150/80	9	Moderate	4	8.5	3.3	4	A
27	1042962	VERSHA RAHUL	35	F	no	yes	no	no	no	no	no	yes	no	yes	no	no	E	E	126/80	1	Mild	1	8.9	3.8	2.6	A
28	1043572	REHMANSAB SAYYED	48	M	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	E	B	140/90	10	Moderate	4	9.2	4.7	4.6	A
29	1043606	RENUKA LOHAR	63	F	no	no	no	no	yes	yes	no	no	no	no	yes	yes	D	E	130/80	2	Mild	1	9.8	4.4	4.3	B
30	1043648	PRANESH DESHPANDE	64	M	no	no	no	no	yes	yes	yes	no	no	no	yes	yes	B	E	150/100	3	Mild	1	8.7	4	3	B
31	1043839	MD TAUSEEF BASHEER KAZI	39	M	no	no	no	no	no	no	no	no	no	no	no	no	E	D	140/90	2	Mild	1	10	4.6	5.7	B
32	1043769	BASAPPA MANTUR	55	M	yes	yes	no	yes	no	no	yes	yes	no	yes	no	no	C	E	110/60	18	Moderate to Severe	4	9.8	4.6	5	A
33	1044206	TARAMATI GUNNAGOL	76	F	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	D	E	100/60	19	Moderate to Severe	5	8	2.9	8.8	A
34	1044559	SHUBHAM CHOUGULE	24	M	yes	no	no	no	no	no	yes	no	no	no	no	no	E	A	100/60	4	Mild	1	8.8	3.5	8.5	A
35	1044293	SHIVAPPA CHABBI	76	M	yes	yes	no	yes	no	no	yes	yes	no	yes	no	no	C	B	100/60	14	Moderate	4	7.6	4	3.2	A
36	1043403	SURENDRA PATEL	32	M	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	C	E	140/80	16	Moderate to Severe	5	8.9	4.2	4.1	A
37	1044859	SHRISHAIL MIRJI	61	M	no	yes	no	no	yes	no	no	yes	no	no	yes	no	B	D	130/80	4	Mild	1	8.3	3.8	4.9	A
38	1044883	GORKHNATH JADHAV	60	M	no	yes	no	no	yes	no	yes	yes	no	no	yes	no	A	D	144/90	5	Moderate	1	8.8	3.9	5.8	A
39	1044762	NEELAVVA VAKKUND	72	F	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	A	E	120/70	17	Moderate to Severe	4	8	3.8	2.8	A
40	1045015	MURALIDHAR DALAWAYI	53	M	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	B	C	150/90	13	Moderate	4	8.5	4.1	4	A
41	1044946	ASHOK PUNAJAGOUDA	67	M	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	E	B	130/80	20	Moderate to Severe	5	8.5	3.9	5.8	A
42	1045387	RAJU GUNJIKAR	53	M	no	no	no	no	no	no	no	no	no	no	no	no	D	E	120/70	3	Mild	2	8.7	4.3	8.6	B
43	1045439	ARAVIND DESHPANDE	74	M	yes	yes	no	yes	no	no	yes	yes	no	yes	no	no	D	B	140/80	18	Moderate to Severe	5	8.8	4	4.4	B
44	1046065	SHOBHA TADDEWADI	53	F	no	no	no	no	no	no	no	no	no	no	no	no	D	E	140/80	1	Mild	1	8.6	4.6	2.7	B
45	1046436	MADARASAB JIDDIMANI	62	M	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	C	A	120/70	18	Moderate to Severe	5	8.4	3.5	6.2	A
46	1046181	MARUTI TAVANOJI	68	M	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	E	B	130/70	20	Moderate to severe	5	7.4	3.7	3.7	A
47	1046310	BASAVANEVVA SHERAKHANE	74	F	yes	yes	no	no	no	no	yes	yes	no	yes	no	no	A	E	110/70	9	Moderate	4	6.9	2.7	13.4	A
48	1046048	GULAB BAGAWAN	68	M	yes	no	no	yes	no	no	no	no	no	yes	yes	no	D	E	130/80	6	Moderate	3	8	3.7	5.7	C
49	1047260	SHANMUKHAPPA SIDNAL	85	M	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	E	D	160/110	17	Moderate to Severe	5	7.7	2.8	1.6	A
50	1048033	KALLAVVA KAMBLE	82	F	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	E	E	130/80	18	Moderate to Severe	4	8.4	4.1	4.2	A
51	1047807	MARUTI KOTABAGI	40	M	yes	yes	no	no	no	yes	yes	yes	no	no	no	yes	D	C	160/100	5	Moderate	2	7.9	4.8	5.6	A
52	1048410	GOPAL DOMBAR	56	M	yes	yes	yes	yes	no	no	yes	yes	yes	no	no	no	D	D	90/60	20	Moderate to severe	6	9.3	4.6	6.2	A
53	1049011	RAJAMATI NARASAGOUDA	74	F	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	A	E	160/100	11	Moderate	4	8.7	4.1	8.4	A
54	1048802	KIRAN SUBBARAYA	53	M	yes	no	no	yes	yes	no	yes	yes	no	yes	yes	no	D	A	150/90	17	Moderate to Severe	4	8.1	4.6	6.9	B
55	1049120	IRAVVA ASODEKAR	89	F	no	no	no	yes	yes	no	no	no	no	yes	yes	no	D	E	100/60	6	Moderate	4	8	3.7	8	B
56	1049496	BIBIJAN CHAVAN	70	F	no	no	no	yes	no	no	no	no	no	yes	no	no	B	E	130/70	6	Moderate	4	8.3	3.4	4.4	A
57	1051637	ABEDULLAH SHIROL	48	M	yes	yes	no	no	no	no	yes	yes	no	no	no	no	E	A	130/80	4	Mild	2	8.5	3.2	4.7	A
58	1052248	KIRAN RANAVAGOL	40	M	no	yes	no	no	no	no	no	yes	no	no	no	no	E	A	180/90	9	Moderate	2	8.6	4.4	3.4	A
59	1052161	NIHAR GOTURI	22	M	yes	no	no	no	yes	no	yes	no	no	no	yes	no	E	D	140/90	6	Moderate	3	9.2	4.6	5.4	B
60	1052507	SURENDRA KATTI	64	M	yes	yes	yes	no	yes	no	yes	yes	yes	no	yes	no	D	E	150/90	7	Moderate	3	8.1	4.2	5.8	A
61	1052887	ARAVIND DESAI	77	M	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	D	D	160/110	20	Moderate to severe	5	9.2	4.3	7.5	A
62	1052893	SUSHEELA HAMMANNAVAR	65	F	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no	A	E	90/60	20	Moderate to Severe	5	8.1	4.2	2.4	A
63	1053197	PHILOMENA BRAGANZA	60	F	yes	yes	no	yes	no	no	yes	yes	no	yes	no	no	D	E	110/60	18	Moderate to Severe	6	8.2	3.9	5.3	B
64	1053566	BHEEMAPPA GUDUGUNTA	45	M	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	A	A	150/90	12	Moderate	4	8.3	3.6	3.8	A
65	1053588	KRISHNA KAMBLE	80	M	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	D	D	160/100	13	Moderate	4	8.5	4	8.1	C

Introduction



Objectives

Review of Literature

Methodology

Results

Discussion

Conclusion

Summary

Bibliography

Annexure-I

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Annexure-II

Annexure-III

Annexure-IV