A STUDY ONPROGNOSTIC SIGNIFICANCE OF SERUM FERRITIN IN PATIENTS WITH ACUTE ISCHEMIC STROKE

Submitted in partial fulfillment of the

Requirement for

M.D. DEGREE (BRANCH -I) GENERAL MEDICINE

OF

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

CHENNAI.

DEPARTMENTOFMEDICINE

KILPAUK MEDICAL COLLEGE, CHENNAI.

APRIL 2014

BONAFIDE CERTIFICATE

This is to certify that the dissertation entitled **"A STUDY ON PROGNOSTIC SIGNIFICANCE OF SERUM FERRITIN IN PATIENTS WITH ACUTE ISCHEMIC STROKE"**submitted by **Dr.A.T.MAARAN**to the Tamil Nadu Dr. M.G.R.Medical University, Chennai in partial fulfillment of the requirement for the award of M.D Degree Branch I (General Medicine) is a bonafide research work carried out by him under my direct supervision & guidance.

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I, **Dr.A.T.MAARAN,** declare that, I carried out this work on, **"A STUDY ON PROGNOSTIC SIGNIFICANCE OF SERUM FERRITIN IN PATIENTS WITH ACUTE ISCHEMIC STROKE"** at the Department of Medicine,kilpauk medical college & hospital during the period ofMarch 2013 to October 2013. This is submitted to The TamilnaduDr.M.G.R.Medical University, Chennai in partial fulfillment of the requirement for the award of M.D degree (Branch –I) General Medicine.

Place: Chennai **Dr.A.T.MAARAN**

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ACKNOWLEDGEMENT

At the outset, I wish to thank our Dean **Prof.Dr.P.RAMAKRISHNAN M.D, D.L.O,** for permitting me to use the facilities of kilpaukMedical College and Hospital to conduct this study.

It is with immense honor and gratitude that I specially thank **Prof.Dr.N. GUNASEKERAN M.D, DTCD,**Medical Superintendent & Director INCD, Govt. Royapettah Hospital, Professor& HOD Of Medicine, kilpauk Medical College, Chennai for his supportiveness and guidance in my study work.

Words fall short to describe my deep sense of gratitude and respect that express my utmost thank to my unit chief **Prof.Dr.S.UshalakashmiM.D,FMMC,**a teacher with excellent clinical skills and knowledge for her unfailing inspiration, affectionate guidance and advice throughout the course of present study.Her valuable suggestions, sympathetic, helping nature and encouragement enabled me to attain this achievement.

I would like to acknowledge **Prof.G.Balan M.D, Prof.Dr.T.RavindaranM.D. DNB,DipDiabetology, Prof.Dr.D.Surenderan M.D, DCH** for their support and guidance during the course of the study.

Also I would like to show my gratitude to the **Prof.Dr.Arunan M.D.D.M**&**Prof.Dr.SaralaM.D.D.M,** Department of Neurology, for their supportiveness and guidance to my study work.

I offer my heartfelt thanks to AssistantProfessors**Dr.M.Bhathragiri M.D., Dr.A.Marimuthu M.D,**and **Dr.N.MurugapandianM.D.D.M.,** for their constant encouragement, timely help and critical suggestions throughout the study.

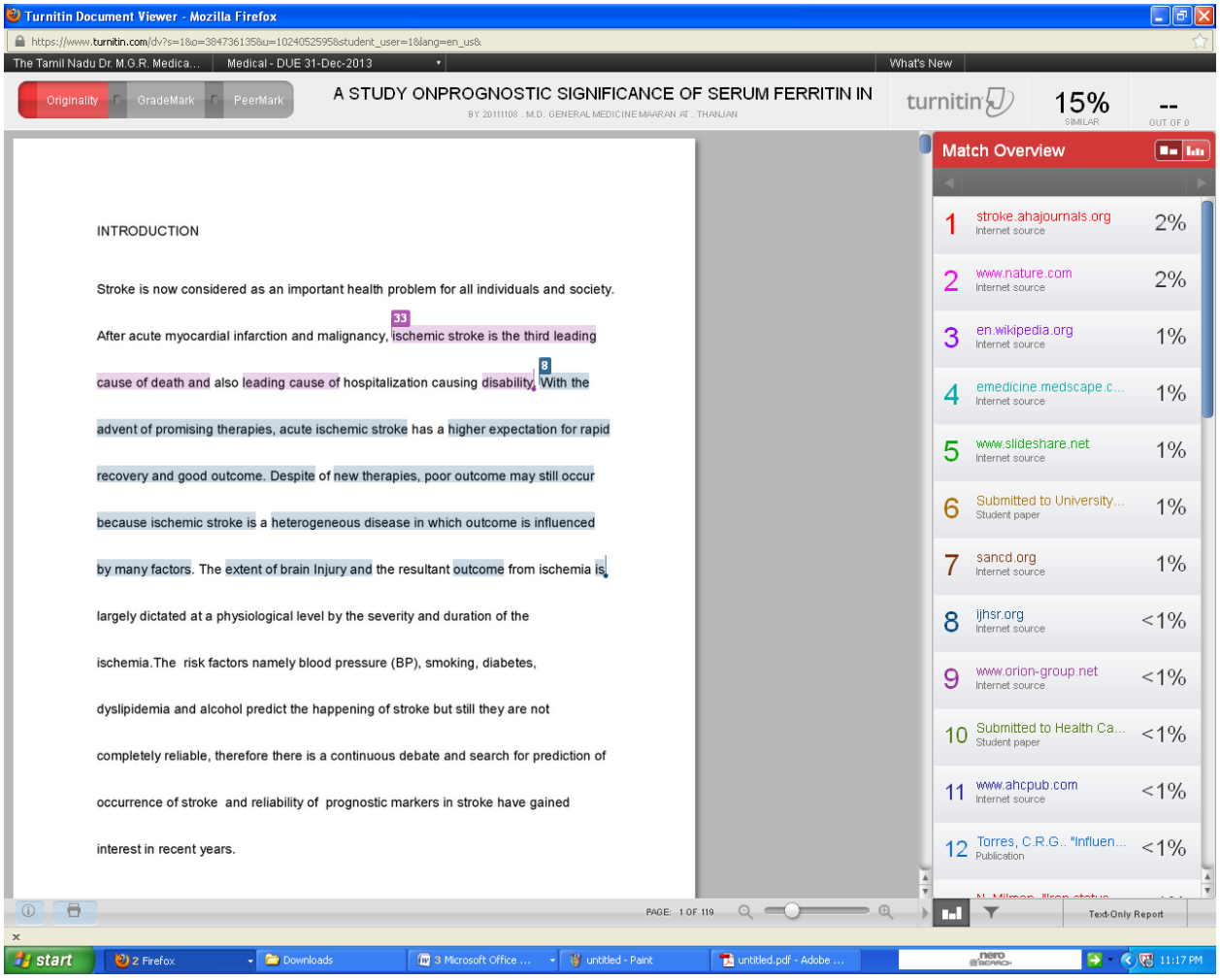
I also express my sincere gratitude**Dr.G.Srinivasaraman DMRD, DNB**

Anderson Diagnostics &Labs**,** Chennai for his supportiveness and guidance

forthis study.

My family and friends have stood by me during my times of need. Their help and support have been invaluable to this study.

Last but not the least I thank all the patients who cooperated with the study in spite of their illness and stigmata. This work would be complete and successful, if it had contributed, even in the small possible way to alleviate their sufferings.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INTRODUCTION
Stroke is now considered as an important health problem for all individuals and society. After acute myocardial infarction and malignancy, ischemic stroke is the third leading cause of death and also leading cause of hospitalization causing disability. With the advent of promising therapies, acute ischemic stroke has a higher expectation for rapid recovery and good outcome. Despite of new therapies, poor outcome may still occur because ischemic stroke is a heterogeneous disease in which outcome is influenced by many factors. The extent of brain Injury and the resultant outcome from ischemia is largely dictated at a physiological level by the severity and duration of the ischemia.The risk factors namely blood pressure (BP), smoking, diabetes, dyslipidemia and alcohol predict the happening of stroke but still they are not completely reliable, therefore there is a continuous debate and search for prediction of occurrence of stroke and reliability of prognostic markers in stroke have gained interest in recent years.
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CONTENTS

Abstract

Background:

Iron is an essential element for the human body. Iron-dependent free radicals formation has been related to greater damage in cerebral ischemia. This study analysed whether increased body iron stores measured as serum ferritin, were associated with early neurologic worsening on the outcome in patients with acute ischemic stroke.

MATERIALS AND METHODS:

This was a cross sectional study (prospective) in which 60 patients who had acute ischemic stroke was included for study. Those patients who got admitted within 24 hours of stroke onset only were taken for study .The data of each patient will be collected on a proforma specially designed for this study and which includes demographic details, clinical features, past medical history, clinical and Lab values which will be analysed for statistical significance and correlation. Clinical status was determined by the NIHSS scale at admission and by MRS scale 4 weeks later. Serum ferritin levels were assayed on admission.

RESULTS:

Among 60 patients 35 patients had high serum ferritin [≥ 300 mg/l (male) , ≥200 mg/ml (female)] and 25 patients had normal ferritin value. Out of these 35 cases that have high serum ferritin, 37.14% of cases come under moderate category and 62.86% cases come under severe category. On the other hand, among the remaining 25 cases who had normal serum ferritin, all the 22 cases come under moderate group and none in severe group. Pearson's r correlation also reveals positive correlation between serum ferritin and NIHSS scores. Pearson's r value is 0.613. A positive correlation exists between these 2 variables with a statistically significant 'p' value. Out of 35 cases with high serum ferritin, 5 cases were in good outcome category and 30 cases in poor outcome category of MRS scores. In contrast among 25 cases with normal serum ferritin, 17 cases were in good outcome (MRS) and 8 cases were in poor outcome (MRS).

Pearson’s r correlation analysis reveals positive correlation between serum ferritin and MRS. Pearson’s r value is 0.560 and is positive variable. Any increase or decrease in serum ferritin score analogous linearly with increase/decrease severity score of NIHSS. Increase in serum ferritin will favors the poor outcome of patients in terms of death and severe disability.

Conclusions:

High ferritin concentration within the first 24 hours from the onset of ischemic stroke are associated with early neurologic deterioration. Increased body iron stores may contribute to stroke progression by enhancing the cytotoxic mechanisms in cerebral ischemia. More research is needed to determine the origin of increased serum ferritin levels and the therapeutic implications. Antioxidants can be added as a part of treatment

protocol in patients with Acute Ischemic stroke. Drugs like Desferroxamine can be used to reduce serum ferritin levels.

KEY WORDS:

- ferritin
- ischemic stroke
- NIHSS,MRS
- prognosis
- Stroke outcome.

INTRODUCTION

Stroke is now considered as an important health problem for all individuals and society. After Acute Myocardial Infarction and malignancy, Ischemic stroke is the third leading cause of death and also leading cause of hospitalization causing disability. With the advent of promising therapies, acute ischemic stroke has a higher expectation for rapid recovery and good outcome. Despite new therapies, poor outcome may still occur because ischemic stroke is a heterogeneous disease in which outcome is influenced by many factors. The extent of brain Injury and the resultant outcome from ischemia is largely dictated at a physiological level by the severity and duration of the ischemia.The risk factors namely blood pressure (BP), smoking, diabetes, dyslipidemia and alcohol predict the happening of strokebut still they are not completely reliable, therefore there is a continuous debate and search for prediction of occurrence of stroke and reliability of prognostic markers in stroke have gained interest in recent years.

In recent years, inflammatory process plays an important role in pathophysiology of stroke. When an individual is exposed to any insult in terms of infection and injury, there is a production of proteins called Acute Phase Proteins. This Acute phase protein participates in all inflammatory process and plays a major role in both acute and chronic inflammatory states. The Acute phase reactants are

fibrinogen, ferritin,haptoglobin, highly sensitive C – reactive protein, Complements (C3), Complements (C4), Tumor necrosis factor. For a longtime serum ferritin was measured only to know the stored iron status. Now it has been suggested that it influences the prognosis of ischemic stroke[1] and also acts as a risk factor for ischemic episodes by enhancing atherogenesis.[2/3]

AIM & OBJECTIVE

1) To analyze the prognostic significance of serum ferritin with severity of Stroke in correlation with stroke scales (NIHSS and MRS).

2) To study the relationship between serum ferritin and various risk factors for Stroke.

REVIEW OF LITERATURE

As per World Health Organization , Stroke is defined as a clinical syndrome consisting of 'rapidly developing clinical signs of focal (at times global) disturbance of cerebral function, with duration lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin'. A transient ischemic attack (TIA) is defined as stroke symptoms and signs that resolve within 24 hours. The above definition do not include retinal symptoms (sudden onset of monocular loss), which should be considered as part of the definition of stroke and TIA. A non-disabling stroke is defined as a stroke with symptoms that last formore than 24hours but later resolve, without any permanentdisability. This definition includes stroke due to cerebral infarction, Primaryintracerebralhemorrhage (PICH), intraventricularhemorrhage, and subarachnoidhemorrhage (SAH); it excludes infarction caused by infection,tumor,subdural hemorrhage, and epidural hemorrhage.

EPIDEMIOLOGY

It is the second commonest cause of death and fourth leading cause of disability worldwide[4]. In United States, stroke remains the most common cause for disability, second most common cause of dementia and third most common cause of death. Stroke also predisposes to epilepsy, depression and falls[5].It isthe leading cause of functional impairments, among these, 20% of survivors of stroke require institutional careafter 3 months and 15% - 30% of them were being permanently disabled[6.] According to the World Health Organization (WHO), 15 million people suffer stroke worldwide each year. Among them5 million deaths were reported and 5 million were permanently disabled[7].

TABLE 1 Morbidity and Mortality of stroke[8]

		Global Stroke	**India**
1.	Strokes per 100,000	400-800	55.6
2.	Million deaths	5.7	0.63
3.	Million new acute strokes every year	15	1.44-1.64
4.	DALYs (disability adjusted life-year)	28,500,000	6,398,000 DALYs
5.	Case fatality rate	17%-35%	18-41%

As per Indian Council Medical Research (ICMR) reports, Stroke and Diabetes together brings the estimated national economic loss of approximately 46 billion dollars in India between 2006 to 2015. India's growth of grossdomestic product (GDP) is estimated to fall by 1% [8].

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CLASSIFICATION OF STROKE [9]

Stroke can be classified in different ways.

Based on Clinical features [10]

1. Completed stroke.

2. Stroke in Evolution.

3. Transient Ischemic Effects.

4. Reversible Ischemic Neurological Deficit.

Based on Anatomical Location

1. By vascular supply

a. Carotid artery

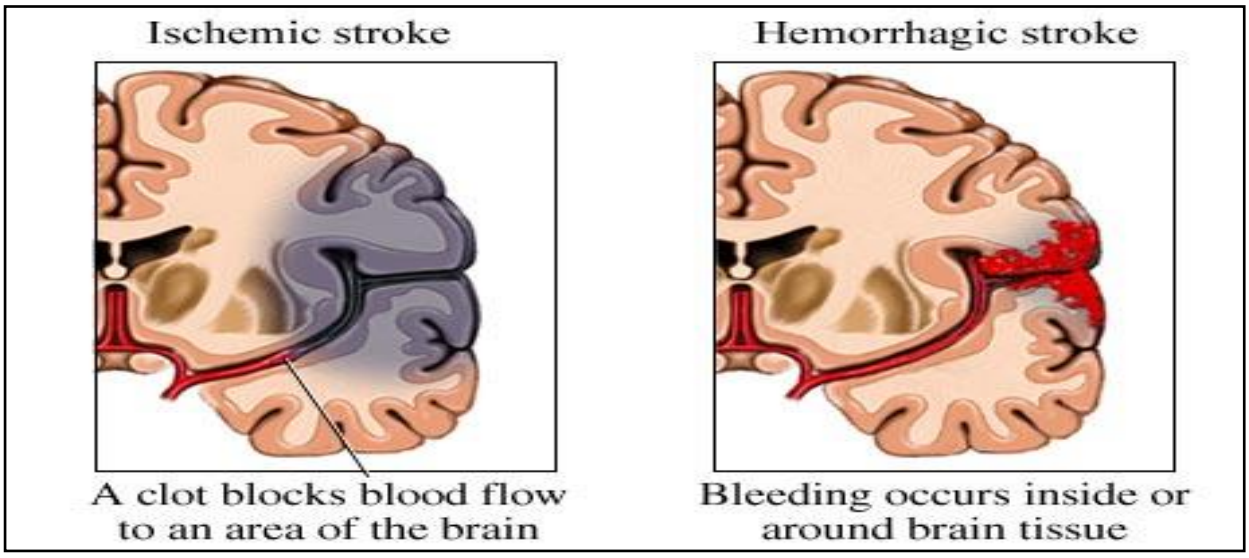
b. Vertebrobasilar artery

2. By location

a. Supra-tentorial which includes lobar and Capsulo-gangilionic

b. Infra-tentorial which includes brainstem and cerebellum

3. By pathology



4. Based on Etiology[3]

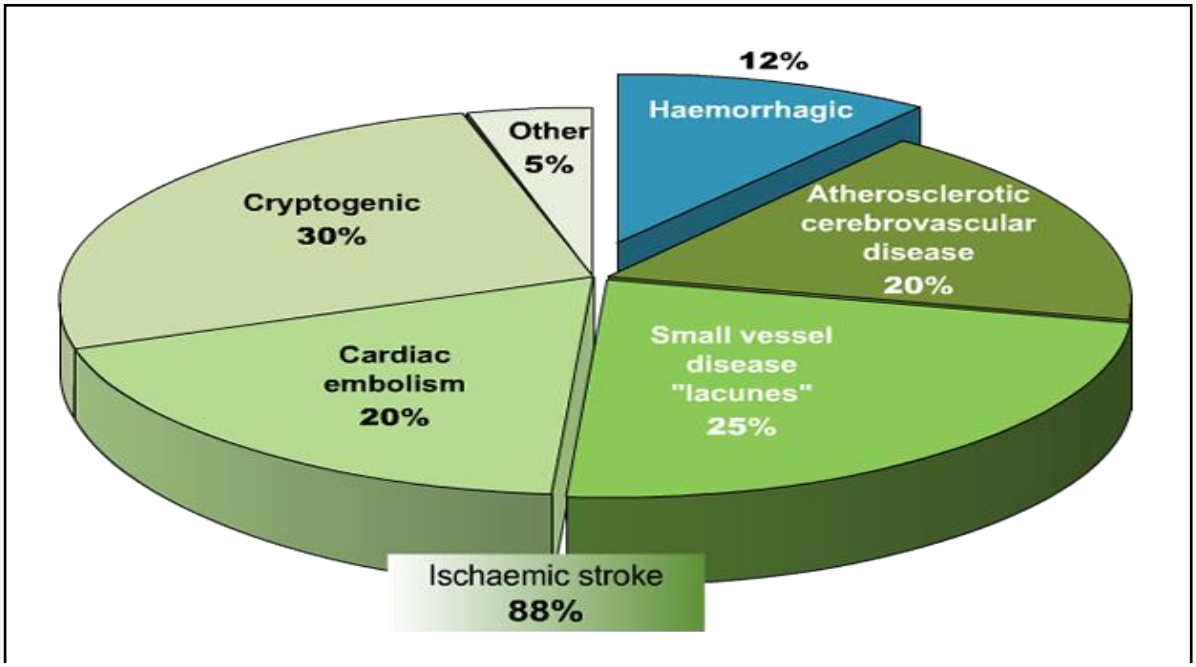


TABLE 2 ETIOLOGIES

1.	Thrombosis i. Large vessels disease ii.lacunar stroke (smallVessels) iii.Dehydration	5.	Cardiogenic i. Marantic Endocarditis ii. Libman sacks Endocarditis iii.Intracardiac mass iv.Mitral valve calcification v.Atrialmyxoma
2.	Embolic Occlusion i.Cardio –embolic a. Myocardial infarction b.Mural thrombus c.Atrial fibrillation ii.Dilated cardiomyopathy	6.	Vasculitis i. Primary CNS vasculitis ii. Systemic Vasculitis – 1.Wegener'sGranulomatosis 2.Polyarteritis nodasa 3.Takayasu arteritis 4.. Giant cell arteritis
3.	Valvular lesions i.Mechanicalvalves ii.Mitralstenosis iii.Bacterial Endocarditis iv.Atria septal aneurysm v.Spontaneous ECHO contrast vi.Paradoxical embolus: PatentForamen ovale, Atrialseptal defect	7.	Meningitis (Tuberculosis, syphilis, bacterial, fungal, Bacterial, Zoster)

4.	Artery to Artery a.Aortic arch b.Carotid artery bifurcation c.Arterial dissection	8.	Hypercoagulable disorders i.Antiphospholipid Antibody Syndrome ii.Protein C,S deficiency iii.Antithrombi III deficiency iv.Prothrombin v G20210 mutation vi.Systemic lupus erythematosis vii.Thrombotic thrombocytopenic Purpura viii.Disseminated Intravascular coagulation x. Systemic Malignancy xi.Inflammatory bowel disease xii.OralContraceptive pills xiii.Homocysteinemia. xi. Dysproteinemias
		9.	Eclampsia,Moyamoya disease
		10.	Drugs –cocaine, Amphetamine
		11.	Subarachnoid hemorrhage

TABLE 3 RISK FACTORS[12]

	IRREVERSIBLE		MODIFIABLE
1.	Age	1.	Raised Blood Sugar
2.	Sex (male > female, not applicable in very young and very old)	2.	Hypercholesterolemia
3.	Hereditary	3.	Elevated Blood pressure
4.	Race (Africo-carribean population >Asian population> European population)	4.	Smoking
5.	History of migraine headaches	5.	Sickle cell Anemia
6.	Fibro muscular dysplasia	6.	Polycythemia
		7.	Excessive consumption of alcohol
		8.	Cardiac Causes 1. Atrial fibrillation 2. Infective endocarditis 3.Heart Failure 4.Hypertrophy of left ventricle 5.Recent myocardial infarction 6.Congenital heart disease and malformations 7. Mitral stenosis
		9.	Oral contraceptive pills
		10.	Physical inactivity
		11.	Head and neck injuries

AGE:

Age is the single most powerful risk factor for cerebral infarction. Incidence of stroke increases with increasing age , doubling or tripling with every decade after the fifth [13] .

SEX:

Men are more commonly affected with stroke than women. Young stroke is more common in young female using oral contraceptive pills and in pregnant individuals. Mortality rates for men are 23% to 115% higher than for women in all countries[14] .

RACE:

The occurrence of ischemic stroke is more common among the Asians and Blacks. There is generally a higher incidence of all stroke types and cerebral infarction in blacks[15.]

HYPERTENSION:

The risk of stroke is increased four to six times in hypertensive patients. Since hypertension promotes the atheroma formation in all sized vessels of brain, hypertension is considered as important risk factor for stroke. Prolonged treatment of diastolic BP to produce a fall of 6mm Hg decrease the stroke risk by 40% and the benefits occur within 3 years[16] .

DIABETES:

Diabetic individuals are three times more prone for than individuals who are not diabetic. Diabetes also promotes the atheroma formation, thereby increasing the rate of occlusion of intracranial arteries. Impaired glucose tolerance may be a risk factor and elevated glycosylated hemoglobin may be found in up to 42% patients with cerebral infarcts not previously known to have diabetes.

SMOKING:

Smoking increases the stroke risk by two times. Smoking causes vasoconstriction, increases fibrinogen concentration, causes polycythemia, reduces aggregation of platelets, all these contributes stroke occurrence. There is a dose response relationship, the risk doubling in the heaviest of smokers[17]. In the Framingham study, cessation of smoking removed the additional risk of stroke within 2 years.

ALCOHOL:

High Alcohol Consumption increases the risk of stroke. There is evidence for an association between sudden heavy drinking and the onset of cerebral infarction in young adults[18.] Chronic light alcohol intake is associated with a decreased risk of stroke[17]. Chronic heavy consumption 180 – 400 g/wk is associated with an increased risk.

Transient Ischemic Attacks

The incidence of stroke increases after TIA. The relative risk of stroke after TIA is 13.4 in the first 12 months and 7 over first 7 years [19]**.**

TABLE 4 Syndromes of cerebral infarction[20]

Carotid Artery occlusion
1. Amarouxfugax which is also known as transient monocular blindness**.** 2. Speech disorder 3. UMN type of facial palsy 4. Loss of sensation in one half of the body(cortical type of sensory loss) 5. Weakness of one half of the body. 6. Hemianopia

Anterior cerebral artery Infarct23		
Relation to anterior communicating Artery	Distal (peripheral)	Proximal
1.	Contralateral hemiplegic Hemi sensory loss with predominant lower limb involvement	Complete hemiplegia
2.	No facial involvement	Facial involvement on the opposite side of the body with or without aphasia
3.	Urinary incontinence	
4.	Emotional disturbances	
5.	Presence of released reflexes	

Middle cerebral artery stroke		
Occlusion of Stem of Middle cerebral artery	Occlusion of proximal superior division of MCA	Occlusion of Inferior division of MCA.
a. Global aphasia	a. Motor weakness,	a.Wernicke's aphasia without weakness
b. Contralateralhemiplegia	B.Sensory disturbances.	B.Quadrantopsia sometimes.
c. Contralateral hemianaesthesia	c.Motor aphasia	c.Innon dominant hemisphere, hemi neglect and spatial agnosia can occur without weakness.
d. Contra lateral hemianopia		
e. Apractagnosia, dysarthria, contra lateral neglect in non dominant hemisphere involvement.		
The MCA supplies the upper extremity motor strip. So weakness of the arm and face is usually worse than that of the lower limb.		

Posterior cerebral artery syndrome	
Signs and symptoms	**Structures involved**
a.Homonymous hemianopia	Calcarine cortex
b.Cortical blindness, denial of blindness, apraxia of ocular movements	Bilateral occipital lobe involvement
c.Dyslexia without agraphia	Dominant calcarine lesions
d.Memory defect	Dominant temporal lobe

Vertebral artery Occlusion

Wallenberg's syndrome occurs due to the Posterior inferior cerebellar artery occlusion (PICA), vertebral, or superior, middle or inferior lateral medullary arteries. This syndrome is characterized by contralateral impaired pain and temperature sensation (spinothalamic tract involvement) and the same side numbness over half of the face, ataxia, Horner's syndrome, dysphagia, vertigo, hiccups and loss of taste sensation.

Basilar artery syndrome

Complete basilar artery syndrome causing coma due to ischemia of high midbrain reticular activating system, quadriparesis along with facial involvement, ophthalmoplegia and loss of corneal and pupillary reflexes. Partial basilar artery syndromes will usually results in top-of-the-basilar syndrome, locked-in syndrome.

In locked in syndrome, the pathology is infarction of base of Pons resulting in quadriparesis along with loss of facial expressions, loss of horizontal eye movements. Consciousness is retained due to sparing of reticular activating system, with presence of vertical movement of eye.

In top-of-the-basilar syndrome, the presenting clinical picture will be hemianopia or complete cortical blindness, amnesia vertical gaze palsies, and hallucinations.

Single perforating artery Occlusion

'Lacunar syndrome' occurs mainly due to the occlusion of one of many arterioles which arises perpendicularly from large parent artery to supply little areas in deep areas of brain and brain stem. Here, the affected individual will not have any features suggestive of aphasia, hemianopia, neglect and conjugate deviation of eyes[20].

TABLE 5 LACUNAR STROKE TYPES

Clinical features	Structure involved
Pure motor hemiparaesis	Infarct in the basis pontis, posterior limb of Internal capsule,
Pure sensory stroke	Ventral thalamus infarct
Ataxic hemiparaesis	Pons -Ventral portion infarct
Dysarthria and clumsy hand syndrome	Genu of internal capsule infarct

Pathophysiology

Acute ischemic strokes result from vascular occlusion secondary to thromboembolic disease. Ischemia causes cell hypoxia and depletion of cellular ATP. Without ATP, theenergy to maintain ionic gradients across the cell membrane is lost leading to cellular depolarization. Cytotoxic edema results from influx of sodium and calcium ions and passive inflow of water into the cell[21, 22, 23].

Ischemic core and penumbra

An acute vascular occlusion produces heterogeneous regions of ischemia in the affected vascular territory. Affected regions with cerebral blood flow of lower than 10 ml/100 g of tissue/min are referred to as the core. As the stroke begins the cells in ischemic core die within minutes[24] .

Affected regions with cerebral blood flow of lower than 25 ml/100 g of tissue/min are referred to as ischemic penumbra. Due to marginal perfusion for some hours, tissueviability is maintained[24] .

Ischemic cascade

Due to depletion of ATP, membrane ion-transportsystem (sodium-potassium pump) fails resulting in intracellular increase in sodium, thereby increasing intracellular water content. This cellular swelling produces as cytotoxic edema and occurs very early in cerebral ischemia.

Also the Cerebral ischemia impairs the normal sodium-calcium exchange protein resulting in calciuminflux , leading to release of neurotransmitters, such as glutamate, activating N -methyl-D-aspartate (NMDA) and other excitatory receptors present in neurons .

These neurons then become depolarized, causing more calcium influx, furtherreleasing glutamate, and local amplification of the initial ischemic insult occurs. Destruction of the cell membrane and other neuronal structures Occurs due to activation of various derivative enzymes mediated by massive calcium influx[25.] Generation of nitric oxide,arachidonic acid, and free radicals aggravates further neuronal damage.

Within 4-6 hours after infarction,ischemiacauses breakdown of the blood-brain barrier. Following the barrier's breakdown, proteins and water passes into the extracellular space, causing vasogenic edema. This produces mass effect that peak at 3-5 days andover few weeks, with resorption of water and proteinsvasogenicedema resolves[26, 27].

Within hours to days after a stroke, cytokines formation takes place by activation of specific genes, whichcauses further inflammation and dysfunction of cerebral vasculature[25].Ultimately, the ischemic penumbra is affected by these progressive insults, fusing with the infracted core, often within hours of the stroke onset.

Infarction results in the death of astrocytes,the supporting oligodendroglial and microglia cells. The infracted tissue ultimately undergoes liquefaction necrosis and is removed by macrophages, with the reduction in parenchymal volume .As a result of encephalomalacia and cystic change, a well-circumscribed region of

cerebrospinal fluid–like low densityis seen. These chronic changes usually seen in the weeks to months following the infarction.

Hemorrhagic transformation

Hemorrhagic transformation represents the conversion of an ischemic infarction into an area of hemorrhage. In the absence of fibrinolytic treatment the incidence is 5% in uncomplicated ischemic strokes. Worsening of Neurologic deficit will not be always associated with hemorrhagic transformation .The changesinclude small petechial hemorrhages to the formation of hematomas which may need surgical evacuation or decompressivehemicraniectomy.

Mechanisms for hemorrhagic transformationinclude reperfusion of ischemic tissue occurring due to

i. Recanalization of an occluded vessel,

ii.Formation of collateral blood supply around ischemic area,

iii. Blood-brain barrier disruption.

Red blood cells extravasateto produce petechial hemorrhage to frank hematoma[21,28, 29.]

Hemorrhagic transformation of an ischemic infarct occurs within 2-14 days post ictus, oftenwithin a week of event. It common occurs

a).After cardioembolic strokes

b).with larger infarct strokes,[30, 21, 31]

c).following administration of rt-PA in patients whose noncontrast CT (NCCT) scans suggestive of ischemic stroke[32, 33, 34].

Post stroke cerebral edema and seizures

Edema and herniation are the most common causes of early death in patients with hemispheric stroke.Seizures occur in 2-23% of patients within the first few days after ischemic stroke [35]. Stroke also causes chronic seizure disorders infraction ofpatients.

Embolic strokes

Cardiogenic emboli account for up to 20% of acute strokes[36].

Commonly emboli arise from

Valvular thrombi (mitral stenosis,endocarditis, from use of a prosthetic valve)

- Mural thrombi (AMI , DCM ,AF,CCF)

- Atrial myxoma
- Right-sided circulation (paradoxical emboli) with passage through a PFO.
- Extra cranial arteries.

Acute myocardial infarction (AMI) is associated with a 2-3% incidence of embolic strokes, of which 85% occur after the first month of myocardial infarction[37]. Embolic strokes have a sudden onset, with neuroimagingshowing infarcts in several vascular territories or calcific emboli.

Cardioembolic strokes may occur as isolatedor multiple in a hemisphere, or scattered and bilateral; the last two types indicate multiple vascular distributions and are more specific for cardioembolic stroke. Other causes include emboli originating from the aortic arch and diffuse thrombotic or inflammatory processes that can lead to multiple small-vessel occlusions.

Thrombotic strokes

Thrombosis results from injury to and loss of endothelial cells which exposes the subendothelium inturn activating platelet, clotting cascade, inhibition of fibrinolysis, and finally stagnation of blood. Thrombotic strokes usually originate from ruptured atherosclerotic plaques. Turbulent blood flow causes stenosis in the arteries, which favors thrombusformation; atherosclerosis (i.e., ulcerated plaques);

and platelet adhesion. Thus blood clot formed either embolizes or occlude the artery.

Because of widespread atherosclerosis,thrombotic stroke also results due to intracranial atherosclerosis. In younger patients, the causes includes, [21, 38] .

- Hypercoagulable states
- Sickle cell disease
- Fibro muscular dysplasia
- Arterial dissections
- Vasoconstriction due to substance abuse (e.g., cocaine, amphetamines).

Lacunar strokes

Lacunar strokes represent 13-20% of all strokes caused by ischemia. They occur due to occlusion of the middle cerebral arteries penetrating branches, the lenticulostriate arteries, or circle of Willis, vertebral artery, or basilar artery penetrating branches,. They mostly related to hypertension.

Lacunar infarct causes includes:

- Microatheroma
- Lipohyalinosis
- Fibrinoid necrosis as a result of hypertension or vasculitis

- Hyaline arteriosclerosis
- Amyloid angiopathy
- Microemboli

Watershed infarcts

Vascular watershed or border-zone infarcts areinfarction occurring between arterial territories at the most distal areas. They are secondary to embolic phenomenon or to decreased blood flow[39, 40, 41] .

Flow disturbances

Inadequate cerebral blood flow results in stroke symptoms because of decreased blood pressure (and specifically, decreased cerebral perfusion pressure) or as a result of hematologic hyperviscosity from sickle cell disease or other hematologic illnesses, such as multiple myeloma and polycythemia vera.

IMAGING STUDIES

CT SCAN

CT scan helps in the clear differentiation between hemorrhages and infarct and it also helps to detect abscess, tumor mass lesions, extraparenchymalhemorrhages (Extra Dural and Sub Dural hemorrhages) [11.]

Merits:

1. CT distinguishes infarct and hemorrhages and helps the treating physician to decide the line of management. .

2. CT scans are highly sensitive in detecting Subarachnoid Hemorrhage.

Demerits:

1. When CT scans are taken in an acute set up, CT scans will not usually detect the infarct in the first 24 to 48 hours.

2. CT scans misses the small infarct on the cortical surface.

3. Usually CT scans will not detect the posterior fossa lesions due to artifact (bone).

INFARCT: Infarct is evident as hypo dense lesion in CT scan. Hypo dense marking of particular vein, gray enhancement and post contrast enhancement of that particular vein in CT scans favors thrombosis of cortical veins of the brain.

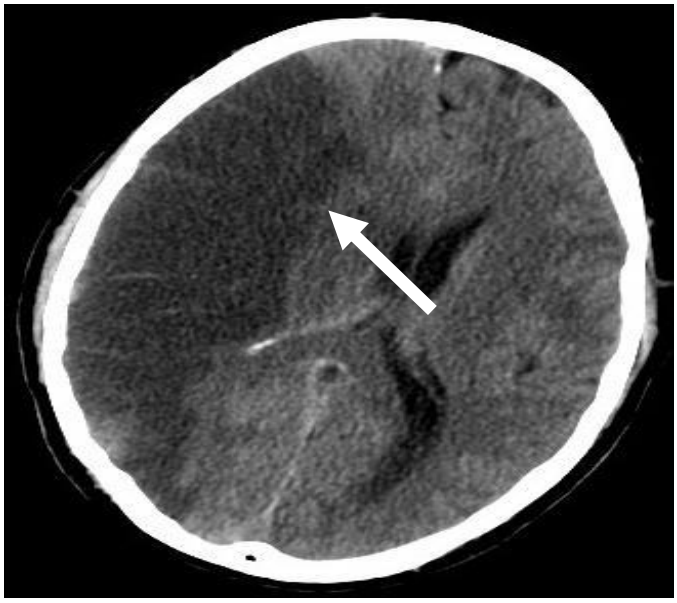


Fig 1 .Ischemic stroke- hypo dense lesion

HEMORRHAGE: A hyper dense area in the film indicateshemorrhages. About 1cm or more in diameter hemorrhages will be detected in CT scans.

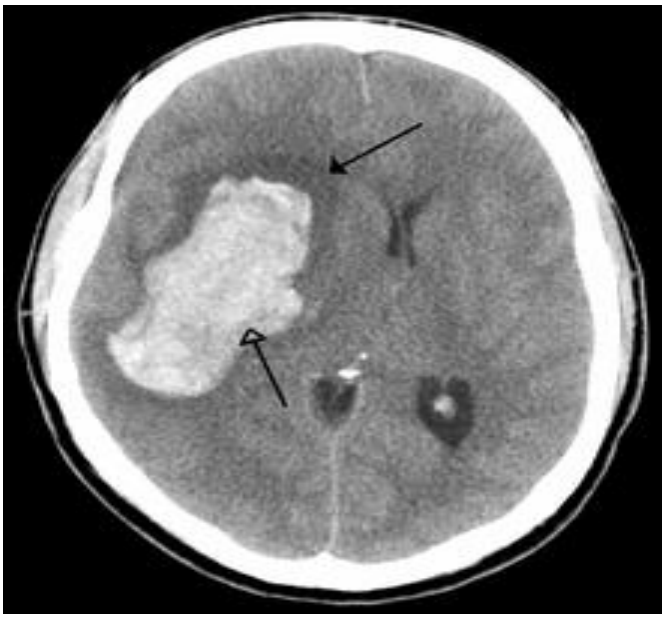


Fig 2 . Hemorrahagic stroke -hyper dense lesion

TABLE 6 CT FINDING IN CEREBRAL INFARCTION[42]

Timing of Infarct	CT Findings
a.Hyperacute (<12 hours)	Lentiform Nucleus obscuration Increased dense lesions (25 – 50 %) Normal (50%)
b.Acute (12 to 24 hours)	Effacement of sulcus,loss of grey and white matter differentiation (Insular ribbon sign)
c.Days 1day to 7 days	Transformation of infarct into hemorrhages, Enhancement of Gyrus, Mass effect, Low density areas which is wedgeshaped, involving white and greymatter.
d.Weeks :1-8	Resolving of mass effects, persistence of contrast enhancement.
e.Months to years	Encephalomalacia changes. Loss of Volume

MRI SCAN [11]

1. Posterior fossa infarction and cortical infarction can be easily identified in these scans and so it was considered superior and more sensitive than CT scans in such lesions.

2. Early brain infarction can be easily determined by Diffusion weighted images and this imaging modality is more sensitive.

3. Stenosis of intracranial vessels and extracranial internal carotid arteries stenosis were detected by MR Angiogram.

COMPLICATIONS OF STROKE [12]

1. Aspiration Pneumonia

2. Urinary tract infection

3. Bed sores

4. Pulmonary embolism with Deep vein thrombosis

5. Contractures

6. Dehydration

7. Hypoxemia

8. Hyperglycemia

9. Frozen Shoulder and subluxation

10. Constipation

11. Hyponatremia and seizures[12.]

TREATMENT

The laboratory investigation and treatment of stoke should be done in proper order as soon as clinical diagnosis of stoke is made.

Goal of treatment: prevention of brain injury or reversal of ischemic brain damage.

General treatment strategies of Stroke treatment

1. Risk factors for Stroke should be controlled, in order to prevent further cerebrovascular accidents.

2. Prevent stroke complications.

3. Specific pathology and patho-physiologies should be treated [43].

4. Airway should be secured, breathing and circulation should be maintained.

5. Blood sugar should be maintained within normal limits.

6. Emergency non contrast Computed tomography films should be taken, since it helps to distinguish between ischemia and hemorrhage.

7. Points that favors Hemorrhagic stroke at that the time of presentation were initial maximum deficit, altered or diminished level of consciousness and increased blood pressure and the points that denotes infarct were maximal at onset or remits after onset [12].

8. Promotion of recovery of stroke patients.

9. Improve neurological function.

TREATMENT CATEGORIZATION [12]

1. Medical therapy

2. I.V. thrombolysis

3. Anti thrombotic treatment

4. Endovascular techniques

5. Neuroprotection

6. Stroke rehabilitation

Medical management

Aim of therapy:

To restore blood flow around ischemic penumbra.

1. I.V mannitol: Cerebral edema usually peaks around 2nd to 3rd day and it will last for 10 days, so I.VMannitol should be given in order to reduce cerebral edema. If it is not treated, it will result in herniation of the brain and finally it leads to sudden cardio-respiratory arrest and in such cases Hemi-craniotomy, where part of the skull can be removed temporarily.

2. Blood pressure monitoring and its reduction is necessary only when there is

a).Associated myocardial infarction

b).The patient is planned for thrombolytic therapy (>185/110mmHg)

c). Hypertensive emergencies.

3. Deep vein thrombosis prophylaxis should be given, by adding Subcutaneous Heparin (Unfractionated Heparin)

4. Heart rate reduction should be done with β1blocker Esmolol, which helps to restore maintain the mean arterial pressure to brain.

5. Hyperthermia should be treated with cooling blankets.

6. Blood sugar monitoring should be done since hyperglycemia results in poor outcome and it should be maintained around 110mgs/dL [12] .

I.V. Thrombolysis

Recombinant tissue plasminogen activator (rt-PA) is now used as a thrombolytic agent of choice. The incidence of intracranial hemorrhage is minimal with this drug. The time window period for administering rt-PA in patients with ischemic stroke is 3 hours but it can be extended up to a maximum of 6 hours. The recommended dose of rt-PA is 0.9 mg /kg and the maximum dose of this drug is 90 mg. 10% of the drug should be given as i.v. bolus and remainder as intravenous infusion over a period of one hour. Frequent monitoring of blood pressure is necessary while administering this drug, and should be stopped once patient develops signs of neurological deficit and in such case cryoprecipitate should be administered. Urinary catheterization should be avoided for another 2 hours [12.]

Indications for thrombolysis

1. Clinical diagnosis of stroke.

2. Patient should remain in the category of therapeutic window

period of 3 hours.

3. There should not be any evidence of hemorrhage or infarct that

involves more than 1/3 of involved territory, mass effect or edema in CTscan

4. Patient should be >18years.

5. Consent by patient attenders'[12]

Contra indications for thrombolysis

1. BP >185/110 mmHg in spite of treatment.

2. Patient having completed stroke in last 14 days or symptoms suggestive of TIA

3. Patient presenting with any upper and lower Gastrointestinal bleeding in previous 3 weeks,

4. Recent myocardial infarction,

5. Platelets < 1 lakhs / cu.mm; PCV < 25%; Glucose <50 or >400 mgs /dL.

4. Heparin should not be used in preceding 48hours and elevated aPTT / INR.

6. Prior stroke or head trauma in last 90 days or prior intracranial hemorrhage.

7. When patient consciousness is lost (in comatose state) or Patientremaining in a stuporus condition.

ANTITHROMBOTIC TREATMENT

Platelet inhibition: Thrombaxane A2 is prostaglandin, which is a platelet aggregator as well as vasoconstrictor. Aspirin acetylates the cyclooxygenase of

platelets and completely inhibits the platelet plug formation .This platelet plug inhibition is irreversible. The anti-platelet activity of acetyl salicylic acid will remain for at least 8 days. Low dose aspirin should be given as once daily dose. It will inhibit only thromboxane A2 production and the inhibition of prostacyclin is spared. So generally recommended dose for stroke is 50-325 mg/day [12.]

ANTICOAGULATION

Anticoagulation should be advised for all patients with atrial fibrillation due to non valvular heart disease and cardiac disease. Cerebral embolism can be prevented by maintaining INR between 2-3.Vitamin K antagonists effectively brings out this anticoagulation.

Indications of anticoagulation for 3 months include:

1. Left ventricular dysfunction
2. Atrial fibrillation
3. Anterior Q –wave infarction
4. Mural thrombus
5. Congestive cardiac failure

ENDOVASCULAR TECHNIQUES

Endovascular techniques should be planned for all patients for whom thrombolysis failed & thrombolysis contraindicated .These candidates were eligible for

endovascular mechanical thrombectomy. And by this procedure, blood flow to the occluded vessels can be established within 8 hours of stroke [12].

NEUROPROTECTION

Neuroprotective drugs blocks the neuro- excitatory amino acid pathway and it promotes the tolerance of brain to ischemic effects. Some of the drugs which give neuroprotection are Calcium Channel Antagonists (e.g., flunarizine, and darodipine), Non competitive N-methyl–D-aspartate receptor antagonists (e.g., dextromethorpan, eliprodil) and Phosphatidyl choline synthesis (e.g.Citicoline) [43].

STATINS

Satins are the inhibitors of 3-hydroxy -3 methylglutarylcoenenzymeAreductase inhibitor. These drugs were effective in reducing the cholesterol levels particularly low density lipoproteins. And it was found very effective in reducing the incidence of Coronary artery disease and cerebrovascular accidents.

These statins has the following properties:

1. Normalizes the vascular endothelium
2. Reducing inflammation
3. Stabilizes the plaques mainly the central lipid core mass.

4. Reduces the platelet-fibrin thrombi and decreases white clots deposition on the endothelial surfaces.

5. Fibrous caps of atheromatous plaques get strengthened and stabilized.

6. Thrombogenicity of the atheromatous plaques gets decreased [43.]

STROKE REHABILITATION

a) Speech therapy

b) Occupational therapy

c) Physical therapy

d) Pharmacological therapy [12.]

ACUTE PHASE REACTANTS

In 1941, Avery and Theodore J Abernethy coined the term Acute Phase Reactants. Acute phase reactants are the markers of inflammation and they are elevated in inflammation, infection and they tend to appear or rise in the blood whenever the immune system comes in contact with proteins. This elevation of acute phase reactants indicates inflammatory burden and it gets elevated in vascular events [44].Some of the acute phase reactants are

TABLE 7 ACUTE PHASE REACTANTS

a. α1 globulin
b. α2 globulin
c. α1antitrypsin
d. Fibrinogen
e.Fibrinonectin
f. Serum Amyloid A protein
g. Pre-Albumin
h. Ferritin
i. Transferrin

Among these reactants, Pre-Albumin, Transferrin were negative phase reactants, they tend to decrease during inflammatory reactions whereas others increase during any inflammatory and infective conditions[45].

Genetics, Inflammation and CVA

Atherosclerosis considered as chronic, dynamic, inflammatory condition caused by a response to endothelial injury.

Risk factors such as oxidized low-density lipoprotein (LDL) cholesterol, smoking and infections contribute to this injury and atherosclerosis. Host genetic factors modify the response to these environmental insults, although inherited risk for stroke is likely multigenic.

Mutations of number of genes are known to increase susceptibility to ischemic stroke.

TABLE 8 GENES SUSCEPTIBILITY TO STROKE

F2and F5 genes	Increase the risk of thrombosis.
NOS3Nitric oxide synthetase gene	vascular relaxation mechanism [47]
ALOX5AP	Arachidonic acid metabolism[48]
PRKCH	Major signal transduction systems[49]
MTHFR (5,10-Methylenetetrahydrofolate reductase gene)	Hyperhomocysteinemia
CBS (cystathione beta synthetase) gene	homocystinuria
CST3 gene	Amyloid angiopathies
NOTCH3 gene	Cerebral arteriopathy, autosomaldominant, with sub cortical infarcts ,leukoencephalopathy (CADASIL)
2 single-nucleotide polymorphisms on 2q23.3	Early onset ischemic stroke
HDAC9, PITX2, and ZFHX3 genes	Large-vessel stroke

The proposed mechanisms for role of inflammation in cerebrovascular disease are:

a.Soon after an ischemic stroke, acute atherothrombotic event brings out an ischemic necrosis in acute cerebral infarction and brain damage.

b.Formation of athermanous plaques and fatty streaks (atherosclerosis) is a

Life long process.

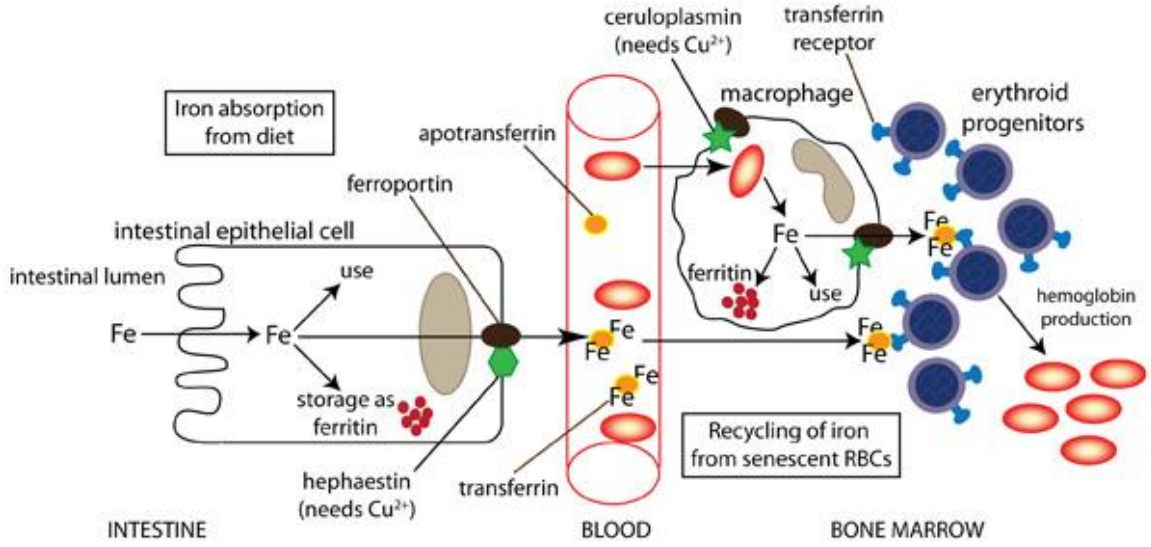
c.In intracerebral hemorrhage, brain injury is delayed.

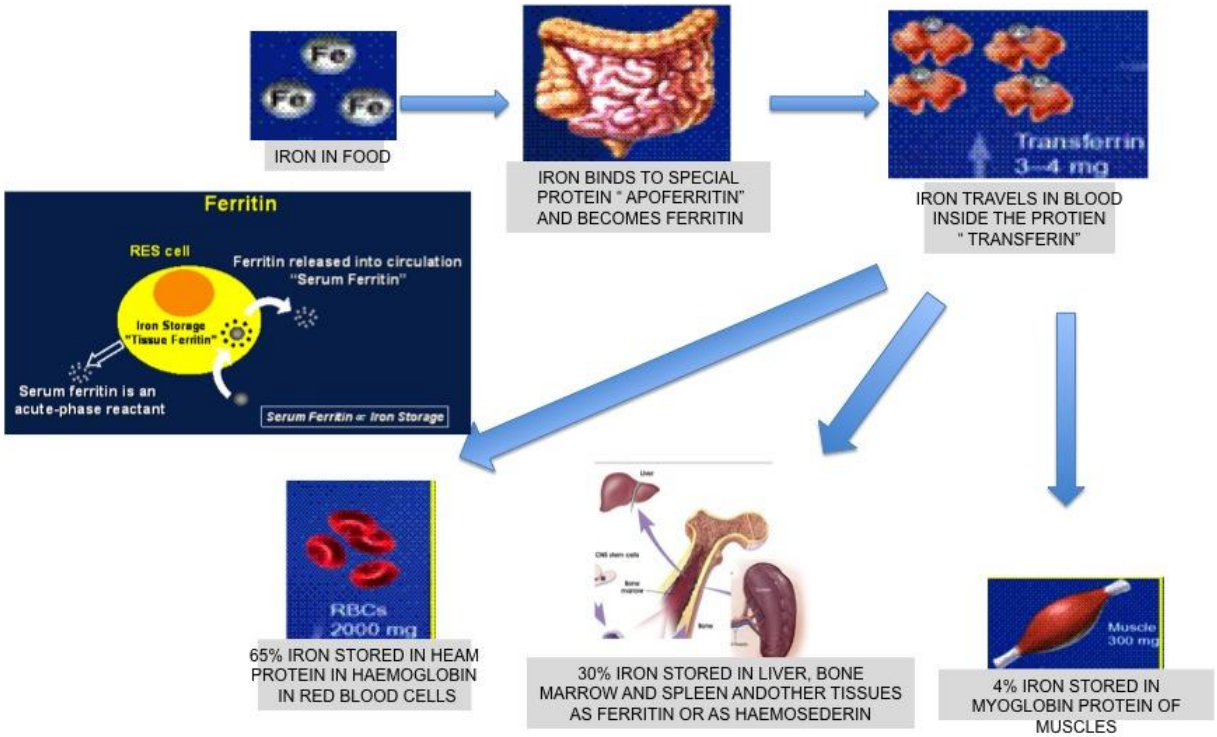
d. Sub-arachnoid hemorrhage causes vasospasm leading on to Cerebrovascular accidents.

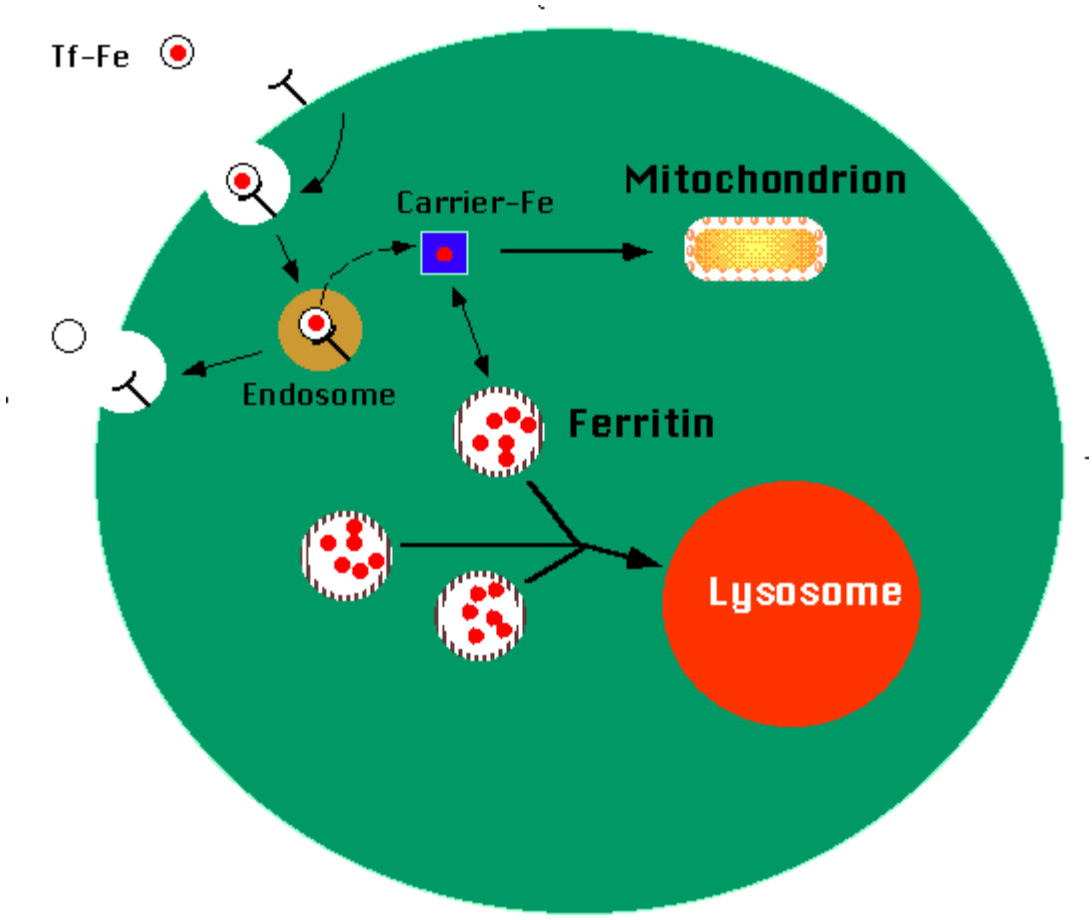
FERRITIN

Ferritin is the cellular storage protein for iron.The principal factor that controls cellular ferritin content is the intracellular level of free iron. Thus, Ft provides a means of storing the metal within cells in available safe manner. Ferritin is also present at a very low concentration in blood but the role of circulating Ft is still unknown. However, serum Ft has been used widely in clinical medicine chiefly as an indicator of body iron stores.Itis an acute-phase reactant involved in cellular defense against oxidative stress and inflammation along with transferring [50].

Fig 3 Synthesis and metabolism:







Iron is stored as hemosiderin (water-insoluble) or ferritin(water-soluble) inside the cell. Theypresent in all cells of the body, tissue fluids. By the action of enzymes present in lysosomes , ferritin is converted into hemosiderin[51.] Ferritin degradation within the cytosol results in complete release of the iron[52.]

The normal range of ferritin includes:

- Males: 30-300 ng/ml
- Females: 10-200ng/ml

Indications:

- To identify iron deficiency condition and monitor
- To see the response to therapy or compliance with treatment
- To distinguish iron deficiency from chronic disease as a cause of anemia.
- To see the iron status in patients with renal diseases.
- To study the iron level and its response to supplements in population.
- To see the response to iron depletion therapy in iron overload states[53].

TABLE 9 CONDITIONS WITH ALTERED FERRITIN LEVEL

Increased	Decreased
• Malignancies	• Iron deficiency
• Hyperthyroidism	• Hemodialysis
• Gaucher disease	
• Myocardial infection	
• Iron overload (hemochromatosis)	
• End-stage renal disease	
• Renal cell cancer	
• Anemia other than iron deficiency[2]	
• Acute and chronic liver disease	
• Infection,inflammation,alcohol	

Structure

Ferritin (Ft) is a complex of iron with the protein apoferritin. It is composed of 24 subunits of two types namely, high and light subunits also named as H and L chains. Its molecular weight corresponds to 440 kilodalton thatcan store up to 4500 atoms of iron.

Functions of ferritin:

1. Iron storage.

2. Ferroxidase activity. The heavy chain of ferritin which has ferroxidaseactivity is involved in the conversion of iron from the ferrous (Fe2+) to ferric (Fe 3+) forms. This limits the deleterious reaction which occurs between ferrous iron and hydrogen peroxide known as the Fenton reaction which produces the highly damaging hydroxyl radical.

3. Immune response, infection, cancer increases the serum ferritin level. Endotoxin is anpositive regulator for the ferritin coding gene.

4. Stressresponse. The concentration of ferritin has been shown to increase in response to stresses such as anoxia[54]

5. Industrialapplications. Ferritin is also used in materials science as a precursor in making iron nanoparticles for carbon nanotube growth by chemical vapor deposition.

Free Radical Damage

Three major molecular events involved in brain damage include calcium overload, acidosis, and increased production of free radicals. Production of free radicals are increased under ischemic conditionsdamage the proteins, nucleic acids and membrane lipidsaffecting the cellular integrity. This oxygen radical activity is more severe during reperfusion after sustained ischemia.

Fenton reaction

(1) $Fe^{2+} + H_2O_2 + H^+ \rightarrow Fe^{3+} + HO\bullet + H_2O$

(2) $Fe^{3+} + H_2O_2 \rightarrow Fe^{2+} + HOO\bullet + H^+$

Ferrous Iron (Fe^{2+}) is oxidized by hydrogen peroxide (H_2O_2) to ferric iron(Fe^{3+}), a hydroxyl radicaland a hydroxylanion. Iron (III) is then reduced back to iron (II), superoxide radical and proton by the same hydrogen peroxide.

Thus reactive hydroxyl radicals formed in the Fenton reaction interacts with lipids to initiate the formation ofoxidized LDL that finally leads to the development offoam cells and progression of atherosclerosis. Thus the sensitivity of neurons to oxidative stress depends on the availability of iron in the ischemic focus. Iron is released from large transport proteins, mainly from ferritin, which forms one third to three quarters of brain iron. In the absence of inflammation, infection andcancer the serum concentration of ferritin is found to be directly proportional to tissue iron stores and can be used to assess their infarct size.

Increased body iron stores also cause progressing stroke by stimulating the release of glutamate, which triggers biochemical reactions that lead to brain cell death .Additionally iron also plays a role in vascular disease by activating platelets via a protein kinase C mechanism.

3. Another proposed mechanism by which iron may play arole in ischemic vascular disease, is through reperfusion injury. After the event of ischemic stroke, reperfusion causesmarked increase in oxygen-radical production as well as a release of iron ions, causing further tissue damage and cellular death.

4. As stroke specificareasare rich in iron, high amounts ofPUFA side chains in membrane lipids and low amountof antioxidant enzymes such as glutathioneperoxidase,superoxide dismutase,and catalase the brain tissues are vulnerable to oxidative stress.

Prognostic significance of serum Ferritin in Acute Ischemic Stroke

Recent animal experiments have suggested that iron overload contributes to the development of vascular diseases by promoting thrombosis after arterial injury supported by study done by Day et al, 2003.High serum Ft on admission of acute stroke patients (within 24 to 48 h after stroke onset) was reported to predict a bad prognosis supported by Davaloset al, 1994, 2000; Erdemoglu and Ozbakir, 2002studies, implicating that increase in body iron stores before stroke onset can aggravate the cytotoxicity of brain ischemia.

NATIONAL INSTITUTE OF HEALTH STROKE SCALE (NIHSS)

NIHSS was developed to asses the impairment caused by a stroke. NIHSS is composed of 11 components, each of which scores a specific ability between a 0 and 4. A score of 0 indicates normal function, while a higher score is indicative of impairment[55] .Total scores range from 0-42 with higher values

Representingmore severe infarcts.

1. Cranial Nerve/ Visual disturbances

2. Level of Consciousness

3. Motor weakness

4. Language/ Neglect – were the four important areas to be taken into account. Even based on this clinical parameter, scores can be computed and severity can be assessed.

Merits of NIHSS

a. Helps in diagnosing Cerebrovascular accidents.

b. To know the prognosis of stroke

c. To determine functional disability

d. Rapid way of assessing the patient, which can be done in 10 minutes.

TABLE 10 NIHSS

Tested Item	Title	Response & Scores
1A	Level of Consciousness	0 – Patient is very alert 1 – Ready to fall asleep, lack of attention, patient will respond to painful stimuli 2 – Patient is not alert or oriented to time, person, place and remains in a state of confusion or frank delirium 3 – Patient is Comatose and not responding to painful stimuli
1B	Orientation Questions	0 – Here patient answers correctly to 2 simple questions. 1 – Patient will answer 1 question correctly 2 – Patient will not answer correctly to any question.
1C	Response to Commands	0 – Patient will do both work and tasks perfectly 1 – Patient will do one task perfectly 2 – Patient will not do both tasks

2	Gaze	0 – Patient has normal horizontal movements 1 – Patient can have gaze palsy which is partial 2–Complete ophthalmoplegia
3	Field of vision	0 – Patients visual field is normal 1 – Patient will have Hemi-anopia which is partial 2 – Patient will have Hemi-anopia which is complete 3 – Here Hemi-anopia is bilateralation
4	Facial Movements	0 – Normal 1 – Here facial palsy is subtle 2 – Patient will have facial weakness which is incomplete 3 – Here facial palsy is complete which is unilateral

5	Motor Functions (Arm) a) Left b) Right	0 – No fall when both forearms are stretched out and kept in supinated position for 10 sec 1 – Fall of forearm and hand occurs but does not hit the bed 2 – Forearm and hands fall and hits the bed 3 – No movement against gravity 4 – Total paralysis
6	Motor Functions (leg) a) Left b) Right	0 – No fall of leg for 5sec 1 – Fall of leg occurs but it doesn't hit the bed. 2 – Fall of leg occurs and hits the bed. 3 – No movement against gravity 4 – Total paralysis
7	Limb Inco-ordination	0 – Normal 1 – Inco-ordination of only one limb 2 – Inco-ordination of two limbs

8	Sensory	0 – Patient will not have any sensory loss 1 – Here sensory loss is mild 2 – Here patient will have severe sensory loss
9	Language	0 – Patient can communicate and comprehend the language properly
10	Articulation	0 – Normal 1 – Articulation defect is mild 2 – Articulation defect is severe
11	Extinction or inattention (Neglect)	0 – Normal 1 – One modality of sensation is loss 2 – Severe loss of sensation

Interpretation of NIHSS Score

0 – No stroke

1-4 – Minor stroke

5-15 – Moderate stroke

16-20 – Moderate to severe stroke

21-41 – Severe stroke

Modified Rankin Scale (MRS)

Parameters: MRS carries a total score of 0-6.

TABLE 11 MRS

Score	Observations
0	Patient should not have any symptoms at all
1	Patient should not have any significant disability in spite of presence of symptoms and can able to perform routine daily normal activities
2	Patient will have slight disability and the person cannot perform all routine activities but manages to do his personal work without help
3	Patient is having moderate disability and needs some help, but able to walk without assistance.
4	Patient will have moderately severe disability and cannot walk without help and unable to do his personal affairs without assistance
5	Here patient is having severe disability and the affected individual is bedridden, urinary incontinence will be present and needs continuous nursing care and attention
6	Dead

MATERIALS AND METHODS

SETTING:

Patients admitted in Medical wards, Kilpauk Medical College and Hospital, Chennai.

COLABORATIVE DEPARTMENTS:

Department of Biochemistry, Neurology, Radiology, Medicine, Kilpauk Medical College and Hospital.

STUDY DESIGN:

Cross sectional (Prospective)observation study

PERIOD OF STUDY:

March 2013 to October 2013

STUDY POPULATION:

60 Acute ischemic stroke patients admitted in medical wards, Kilpauk Medical College and Hospital.

DEFINITIONS FOLLOWED IN THIS STUDY:

STROKE:

As per WHO criteria, Acute Stroke is defined as "rapidly developing focal or generalized (for coma patients) neurological alterations in cerebral function with signs and symptoms lasting for more than 24 hours or leading on to death, without any apparent cause for stroke except vascular etiology.

HYPERTENSION:

Hypertension was defined as patients with previous record of at least 2 recordings of >140 / 90 mmHg or patients who are on regular intake of anti hypertensive medications.

DIABETES:

Diabetes was defined as patients with Random Blood Sugar of >200mg/dl, fasting blood sugar of >126 mg/dl, post prandial blood sugar of >200mg/dl or patients who are in need of regular intake of anti-diabetic drugs.

DYSLIPIDEMIA:

Dyslipidemia was defined as patients with Fasting Serum Cholesterol values of more than 220 mgs/dl.

NIHSS SCORE

NIHSS scoring was made based on the clinical parameters. In this study, patients with a score of 1- 4 were considered as MILD, score 5-15 were considered as MODERATE, score >15 were considered as SEVERE category.

MRS score

MRS score of 3,4,5,6 were included under Good Outcome and scores of 1, 2 were considered as Poor outcome.

INCLUSION CRITERIA:

1. All patients with new onset focal neurological deficit following ischemic stroke, presented within 48 hours of onset of stroke are taken into study.

2. Patients >14 years and of both sexes are included in the study.

3. Patients with new onset stroke with past history of hypertension, diabetes mellitus, dyslipidemeia, smoking, alcohol were included.

EXCLUSION CRITERIA:

1. Patients with age more than 80 years were excluded.

2. Patients with malignancy and clinical findings and blood investigations Suggestive of infection were excluded.

3. Individuals with Connective Tissue disorders and Rheumatic heart disease, Coronary Artery diseases were excluded.

4. Patients with prior history of transient ischemic attacks or reversible ischemic neurological deficit, cerebrovascular accidents were excluded

5. Patients with features of hemorrhage such as subdural hemorrhage, Sub-arachnoidhemorrhage and intracerebral hemorrhage were excluded with the aid of CT scan.

6. History of recent surgery and trauma.

7. CNS tumors.

ETHICAL CLEARANCE:

Necessary ethical clearance was obtained from ethical committee, Kilpauk Medical College &Hospital, Chennai.

STUDY METHODS:

60 patients who had acute ischemic stroke were included for study. Those patients who got admitted within 24 hours of stroke onset only were taken for study. As soon as patient got admitted, verbal consent was obtained from patient or attenders. Then complete relevant medical history, neurological examination, routine blood and CT scan were done and all data were recorded in a standardized proforma.

CT scan was taken to exclude the hemorrhagicstroke. Serum ferritin was taken as soon as patient got admitted in the hospital. National Institute of Health Stroke Scale (NIHSS) scoring was applied at the time of admission and these patients were grouped into mild, moderate and severe .

These Acute ischemic stroke patients were treated according to standard treatment protocols. None of the patients in the study group were thrombolysed. Anti edema measures were adopted with either intravenous Mannitol or oral Glycerol. Modified Rankin Scale was applied to know the functional recovery of the patient after 4 weeks when patient is on follow up and attending the review op.

STATISCAL METHODS

All the collected data were computed in master chart. Statically data analysis was done. Chi Square test, Mean, Standard deviation, ‘p’ values were calculated. A ‘p’ value less than 0.05 denotes significant relationship. Pearson’s r correlation test and scatter plot analysis were also done for given data.

RESULTS AND ANALYSIS

SEX DISTRIBUTION

Total number of patients in the study =60 (100%)

Number of malecases inthe study= 38 (63.33%)

Number of femalecases in the study = 22 (36.67%)

TABLE 12 SEX DISTRIBUTIONS

SEX	NO.OF CASES	PERCENTAGE
MALE	38	63.33%
FEMALE	22	36.67%
TOTAL	60	100%

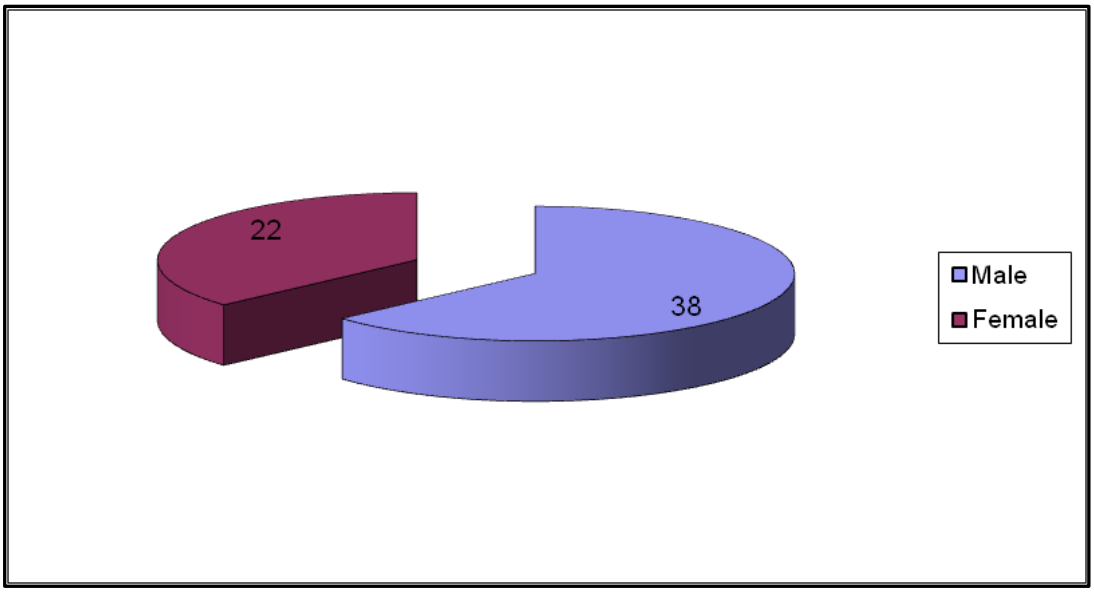


Fig 4 sex distribution

Sex vs.serum Ferritin

Out of 38 male patients, number of male patients who had normal serum ferritin are 16(42.11 %) and the number of male patients who had highserum ferritin 22 (57.89 %).

And out of 22 female patients, 9(40.91%) female cases had normal serum ferritin and 13 (61.9%) female patients had high serum ferritin level.

TABLE 13SEX vs.SERUM FERRITIN

SEX	NO. OF PATIENTS	SERUM FERRITIN		TOTAL
		NORMAL	HIGH	
MALE	COUNT	16	22	38
	%	42.11%	57.89%	100%
FEMALE	COUNT	9	13	22
	%	40.91%	59.09%	100%
TOTAL	COUNT	25	35	60
	%	41.67%	58.33%	100%

p value = 0.927 NOT SIGNIFICANT

The sex and serum ferritin correlation was statistically not significant.

AGE DISTRIBUTION

Out of 60 patients, 14(23.33%) patients were in the age group of ≤ 50 years and 46(76.67%) patients were in the age group of ≥ 50 years.

TABLE 14 AGE DISTRIBUTIONS

AGE (IN YEARS)	NO.OF PATIENTS
≤ 50	14
≥ 50	46
TOTAL	60

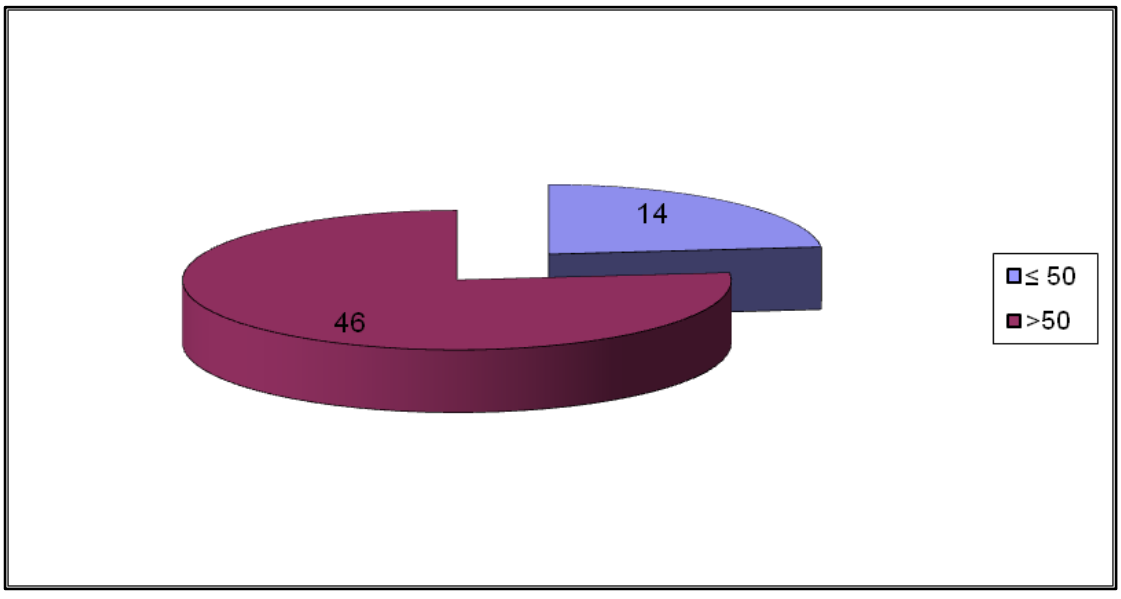


Fig 5. Age distribution

AGE VS SERUM FERRITIN

Out of 14(23.33%) patients who were in the age group of ≤ 50 years, 6 (42.86%) patients had normal serum ferritin and 8 (57.14%) patients had highserum ferritin. Out of 46 (76.67%) patients who were in the age group of ≥50 years, 19 (41.30%) patients had normal serum ferritin and 27(58.70%) patients had highserum ferritin.

Table 15 AGE vs. SERUM FERRITIN

AGE (IN YEARS)	NO. OF PATIENTS	SERUM FERRITIN		TOTAL
		NORMAL	HIGH	
≤ 5 0	COUNT	6	8	14
	%	42.86%	57.14%	100%
≥ 50	COUNT	19	27	46
	%	41.30%	58.70%	100%
TOTAL	COUNT	25	35	60
	%	41.67%	58.33%	100%

p value = 0.918 NOT SIGNIFICANT

The correlationbetween Age andSerum ferritin was statistically insignificant

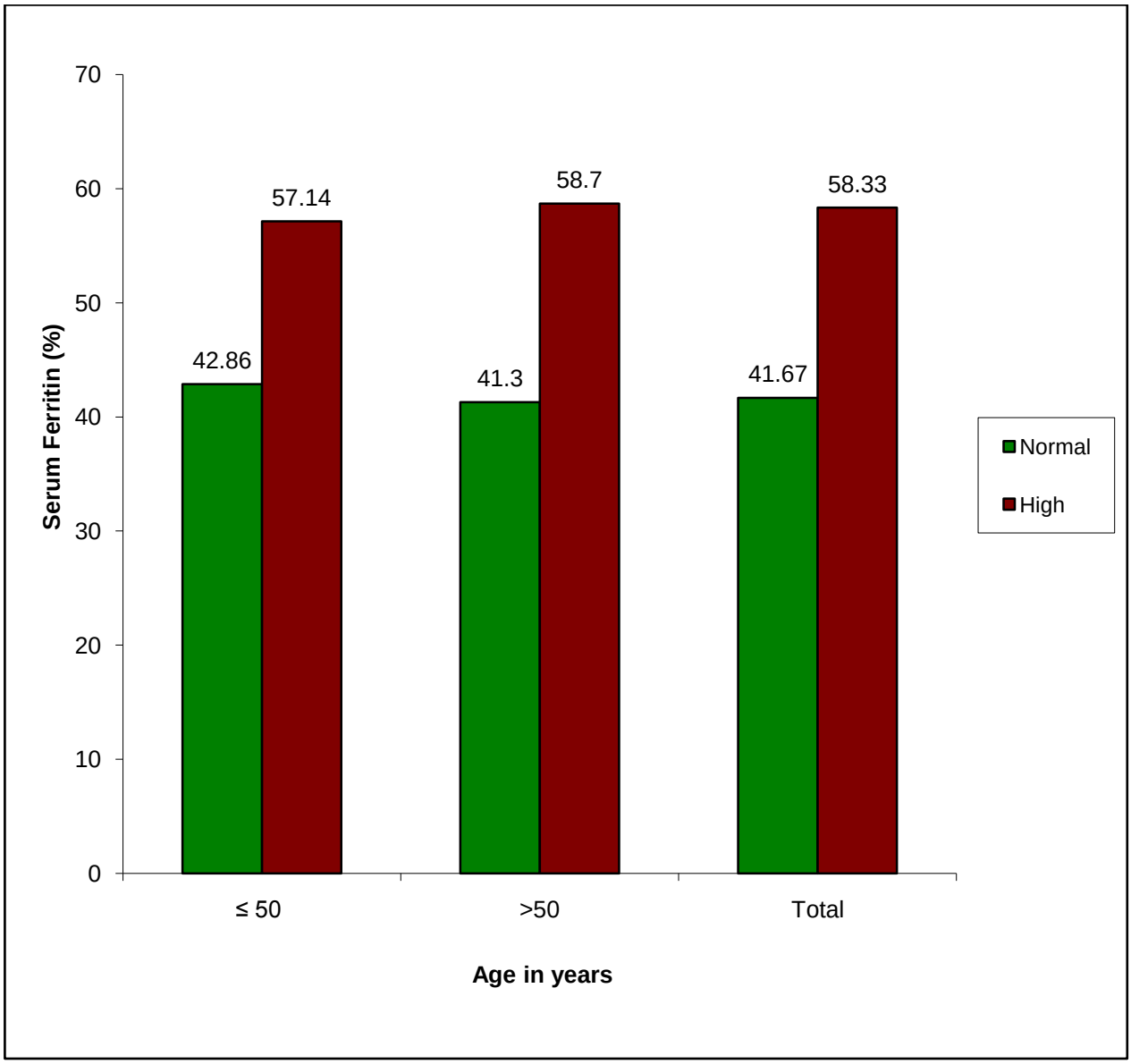


Fig 6.Age distribution

SMOKERS VS SERUM FERRITIN

Serum ferritin profile was done in all 60 cases which include both smokers and non smoker's .Out of 27 patients who are smokers, 14 (51.85%) patients had normal serum ferritin and 13 (48.15%) patients had highserum ferritin.

Out of 33 patients, who are non smokers, 11(33.33%) patients had normal serum ferritin and 22 (66.67%) patients had highserum ferritin.

TABLE 16 SMOKING vs. SERUM FERRITIN

SMOKING	NO. OF PATIENTS	SERUM FERRITIN		TOTAL
		NORMAL	HIGH	
YES	COUNT	14	13	27
	%	51.85%	48.15%	100
NO	COUNT	11	22	33
	%	33.33%	66.67%	100%
TOTAL	COUNT	25	35	60
	%	41.67%	58.33%	100%

p value = 0.236 NOT SIGNIFICANT

The correlation between smoking andserum ferritin was statistically insignificant.

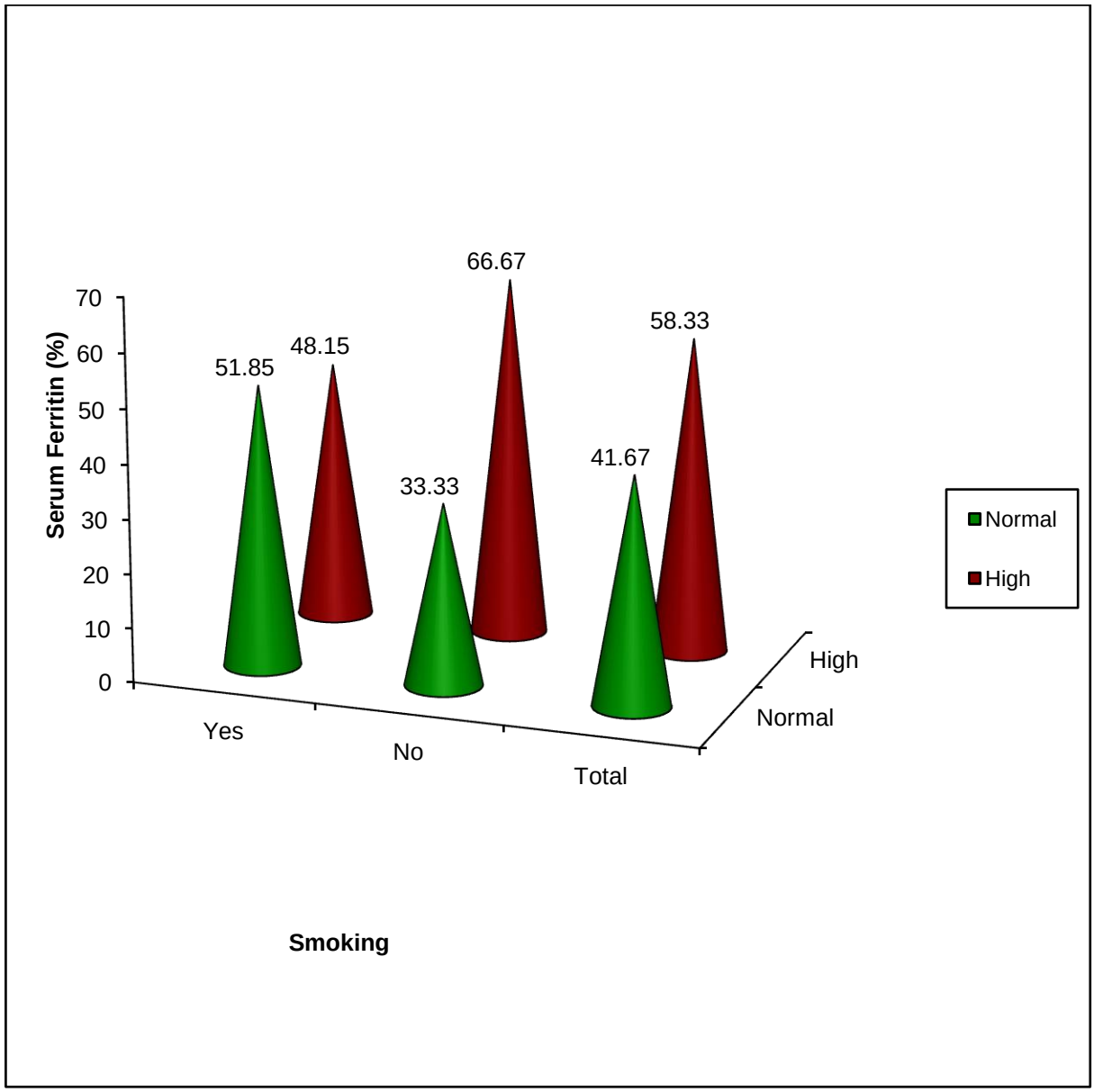


Fig 7.Smoking vs Serum ferritin

ALCOHOLICS vs. SERUM FERRITIN

In both alcoholics and non alcoholics, serum ferritin profile was done. The number of patients with normal serum ferritin were 19(54.29%) and highserum ferritin were 16(45.71%) among total 35 patients who were non alcoholics.

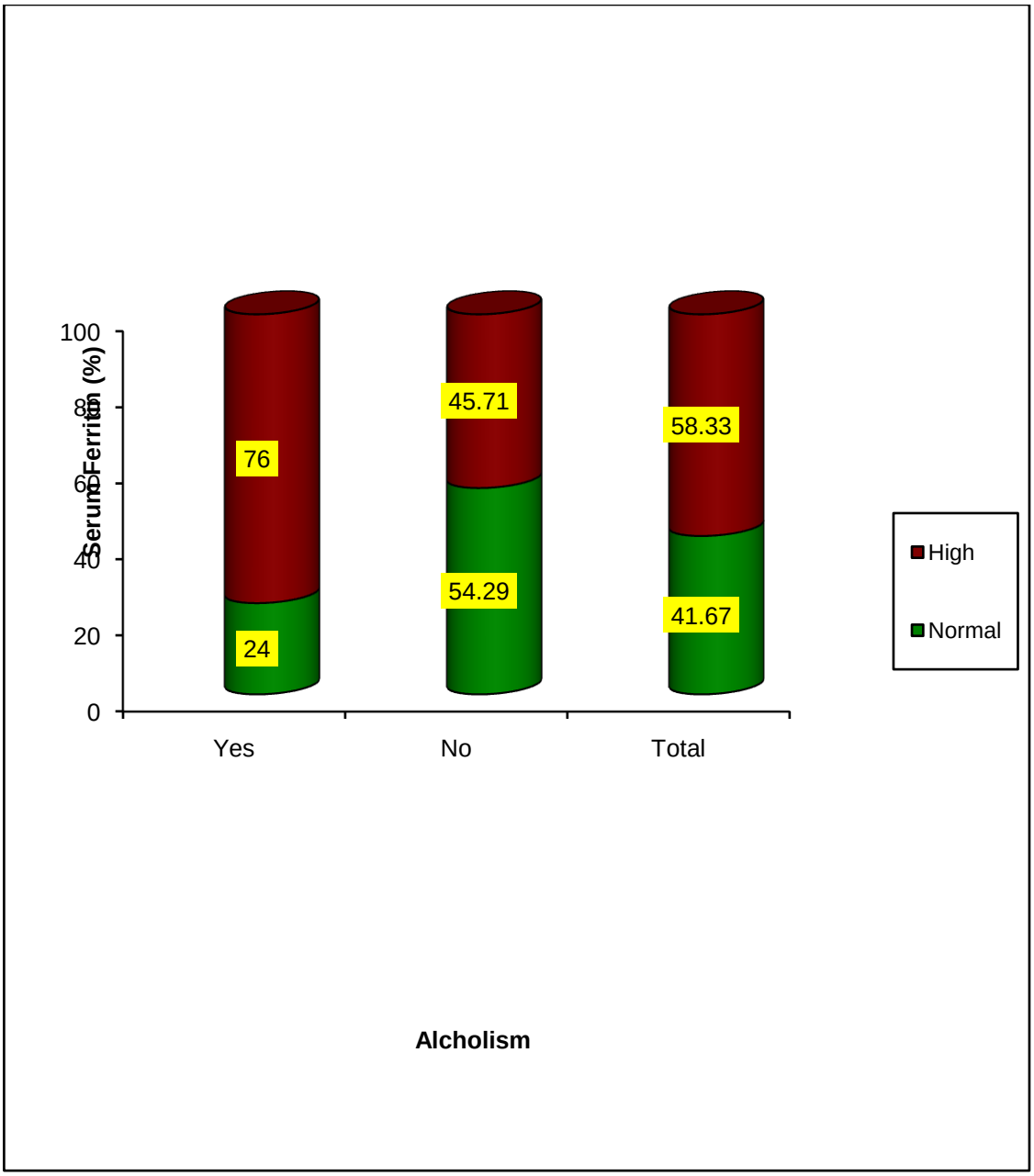
The number of patients with normal serum ferritin were 6 (24.00%) and high serum ferritin were 19 (76.00%) among total 25 patients who were alcoholics.

TABLE 17 ALCOHOLSvs. SERUM FERRITIN

ALCOHOL	NO. OF PATIENTS	SERUM FERRITIN		TOTAL
		NORMAL	HIGH	
YES	COUNT	6	19	25
	%	24.00%	76.00%	100
NO	COUNT	19	16	35
	%	54.29%	45.71%	100
TOTAL	COUNT	25	35	60
	%	41.67%	58.33%	100%

p value = 0.038 SIGNIFICANT

The correlation between Serum ferritin and Alcoholics was statistically significant.


100
80
60
40
20
0
Serum Ferritin (%)
76
24
45.71
54.29
58.33
41.67
Yes
No
Total
High
Normal
Alcholism

DIABETICS vs. SERUM FERRITIN

Serum ferritin values were correlated with both diabetics and non diabetics' patients. Among 16 non diabetics, 11 (68.75%) patients had normal serum ferritin and 5 (31.25%) patients had highserum ferritin.

Among 44 diabetics, the numbers of patients with normal serum ferritin were 14 (68.75%) and with highserum ferritin were 30 (66.7%).

TABLE 18 DIABETES vs. SERUM FERRITIN

DIABETES	NO. OF PATIENTS	SERUM FERRITIN		TOTAL
		NORMAL	HIGH	
YES	COUNT	14	30	44
	%	31.82%	68.18%	100
NO	COUNT	11	5	16
	%	68.75%	31.25%	100
TOTAL	COUNT	25	35	60
	%	41.67%	58.33%	100%

p value = 0.023 SIGNIFICANT

The correlation between Serum ferritin and Diabetes was significant statistically.

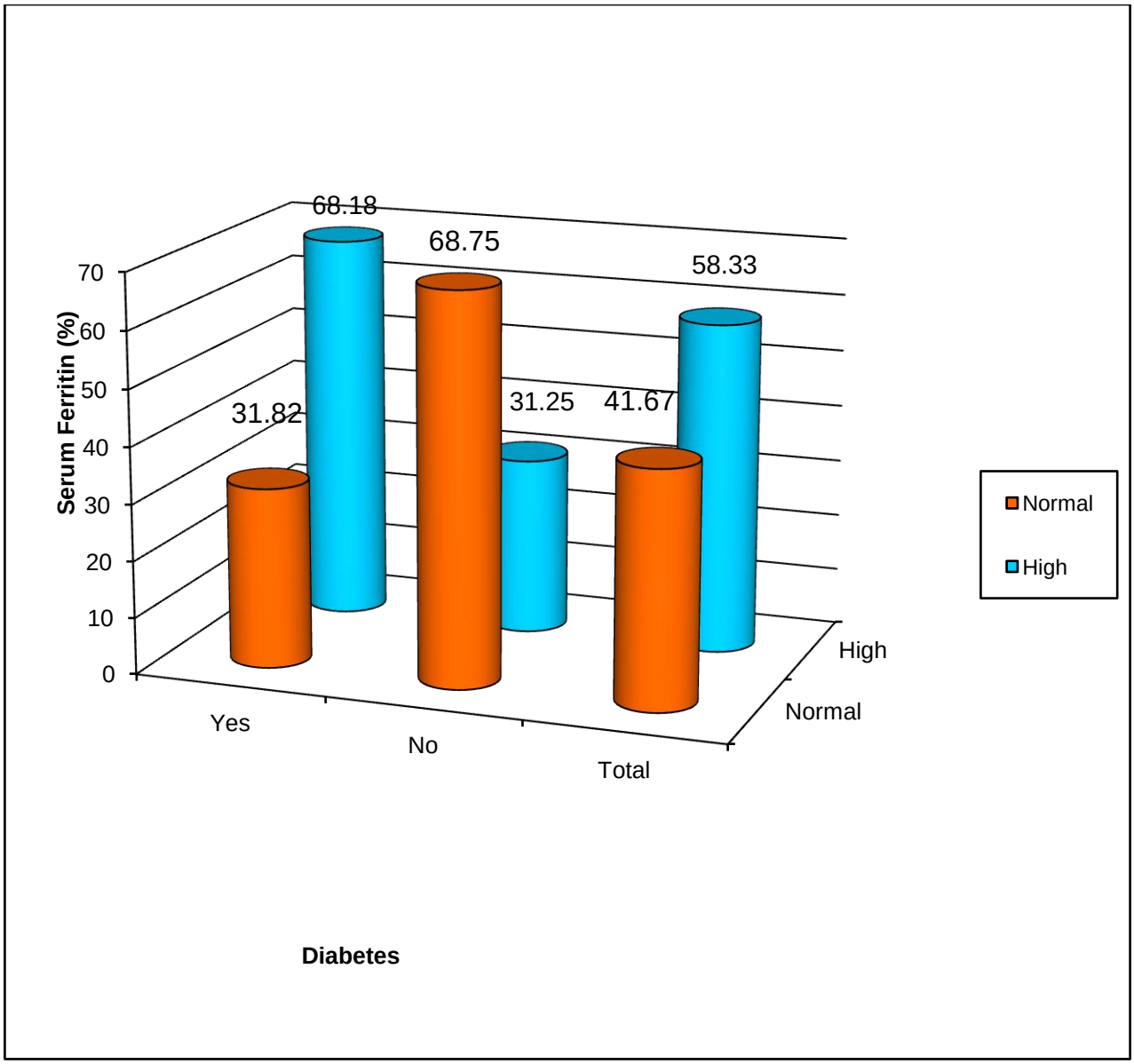


Fig 8. Diabetes vs serum ferritin

HYPERTENSION vs. SERUM FERRITIN

Serum ferritin values were correlated in both hypertensive and nonhypertensive patients. Out of 21 non hypertensive patients, 13 (61.90%) patients had normal serum ferritin and 8 (38.10%) patients had highserum ferritin .Out of 39 hypertensive patients, 12 (30.77%) patients had normal serum ferritin and 27 (69.23%) patients had highserum ferritin.

TABLE 19 HYPERTENSION vs. SERUM FERRITIN

HYPERTENSION	NO. OF PATIENTS	SERUM FERRITIN		TOTAL
		NORMAL	HIGH	
YES	COUNT	12	27	39
	%	30.77%	69.23%	100%
NO	COUNT	13	8	21
	%	61.90%	38.10%	100%
TOTAL	COUNT	25	35	60
	%	41.67%	58.33%	100%

p value = 0.040 SIGNIFICANT

The correlation between serum ferritin and hypertension was statistically significant.

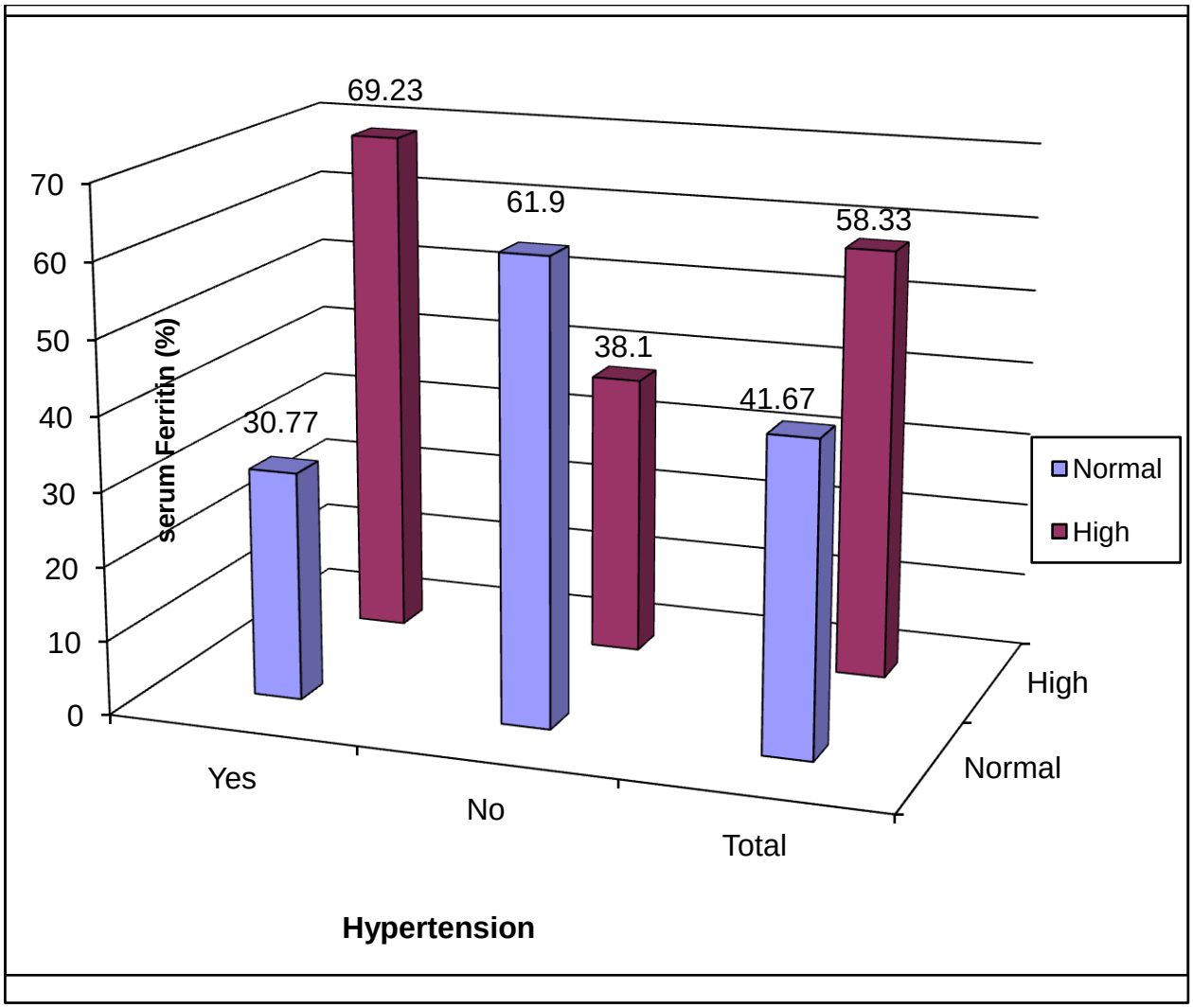


Fig 9. Hypertension vs Serum ferritin

CHOLESTEROL vs. SERUM FERRITIN

Serum ferritin profile was seen in both dyslipidemic and non dyslipidemic patients. Among 34 non dyslipidemic patients, 16(47.06%) had normal serum ferritin and 18(52.94%) patients had highserum ferritin.

Among 26 dyslipidemic patients, 9(34.62%) had normal serum ferritin and 17(65.38%) patients had highserum ferritin.

TABLE 20 CHOLESTEROL VS. SERUM FERRITIN

CHOLESTEROL	NO. OF PATIENTS	SERUM FERRITIN		TOTAL
		NORMAL	HIGH	
YES	COUNT	9	17	26
	%	34.62%	65.38%	100%
NO	COUNT	16	18	34
	%	47.06%	52.94%	100%
TOTAL	COUNT	25	35	60
	%	41.67%	58.33%	100%

p value = 0.481 NOT SIGNIFICANT

The correlation between Serum ferritin and Cholesterol was statistically not significant

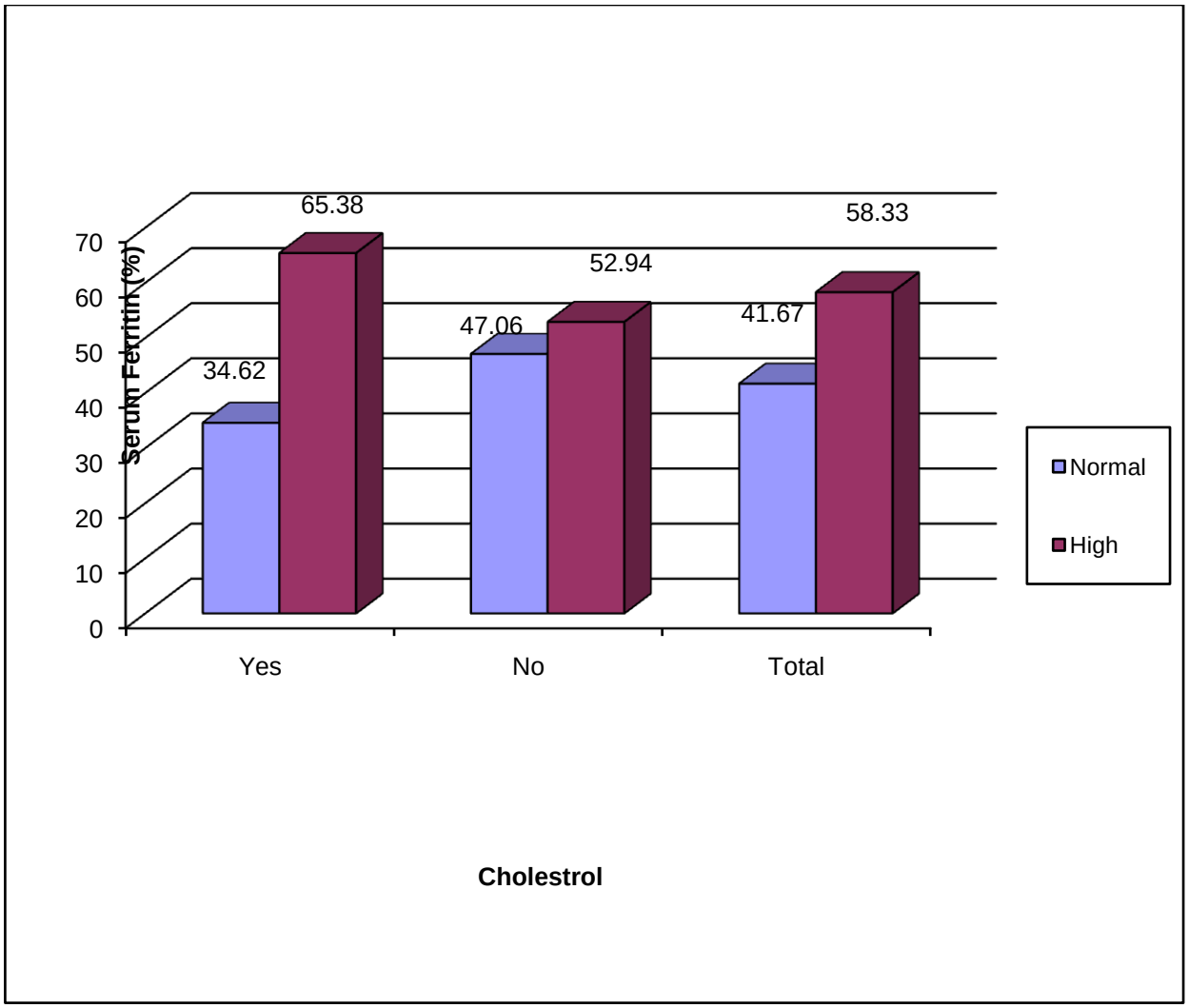


Fig 10. Cholesterol vs Serum ferritin

LOSS OF CONSCIOUSNESS VsSERUM FERRITIN

In Patients with loss of consciousness, serum ferritin profile was done. The number of patients with normal serum ferritin were 24 (51.06%) and highserum ferritin were 15 (48.94%) among conscious patients.

The number of patients with normal serum ferritin were 1 (7.69%) and highserum ferritin were 13 (92.31%) among un-conscious patients.

TABLE 21 LOSS OF CONCIOUS vs. SERUM FERRITIN

LOSS OF CONCIOUS	NO. OF PATIENTS	SERUM FERRITIN		TOTAL
		NORMAL	HIGH	
YES	COUNT	1	12	13
	%	7.69%	92.31%	100%
NO	COUNT	24	23	47
	%	51.06%	48.94%	100%
TOTAL	COUNT	25	35	60
	%	41.67%	58.33%	100%

p value = 0.013 SIGNIFICANT

The correlation between Serum ferritin and Unconscious patients was statistically significant.

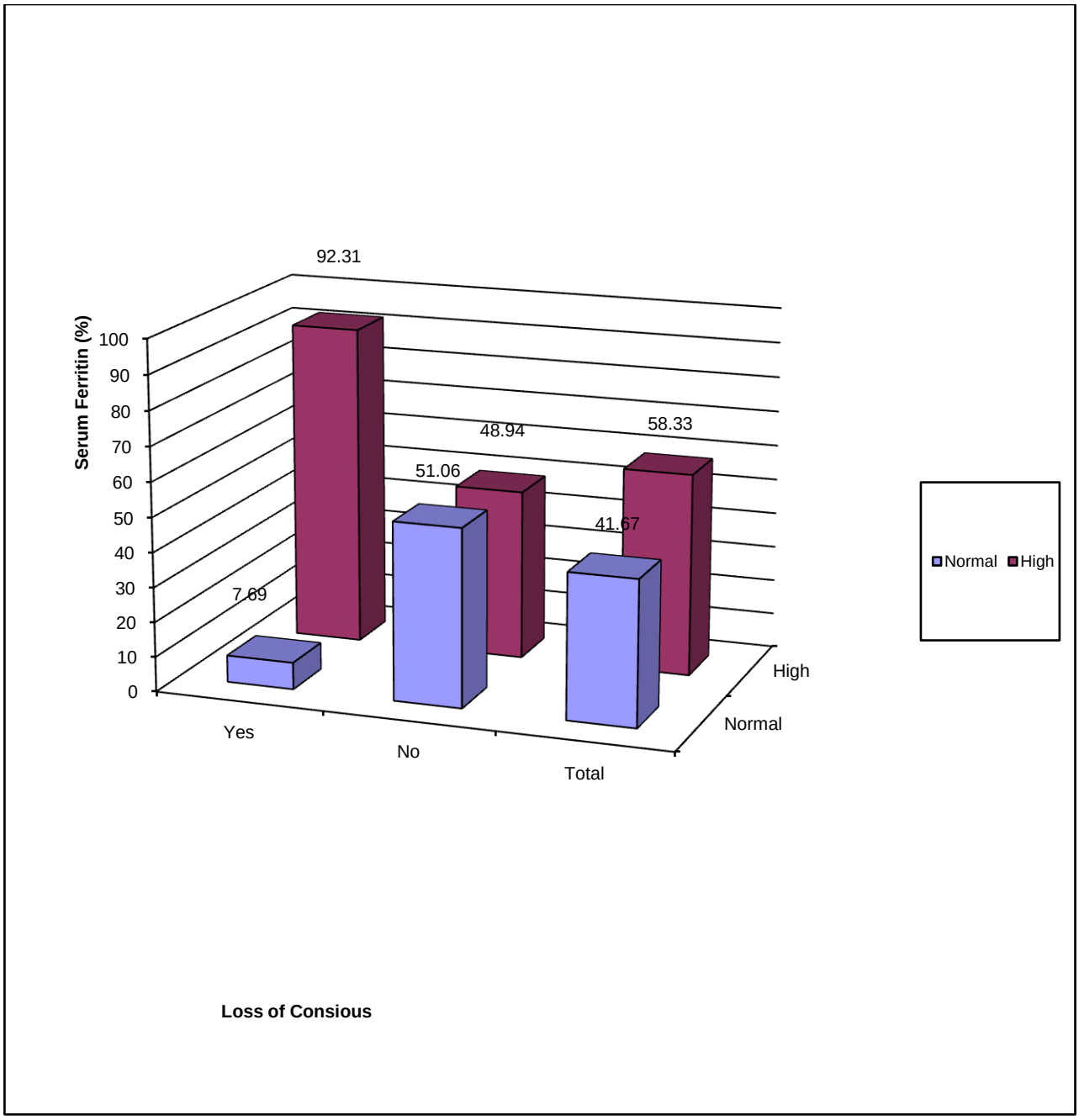


Fig 11. Loss of conscious vs. Serum ferritin

DESCRIPTIVE STATISTICS

The maximum and minimum mean values of serum ferritin in the study are 462.12 and 26.48 with an average mean of 241.39.

The maximum and minimum mean values for NIHSS scoring system in the study is 23 and 5, with an average mean of 14.42.

The maximum and minimum mean values for MRS scoring system in the study is 6 and 1, with an average mean of 3.42.

From this, it is evident that patients with a minimum serum ferritin mean value of 26.48 had

a) NIHSS score minimum mean value of 5 which comes under moderate group and

b) MRS minimum mean value of 1 which comes under good outcome.

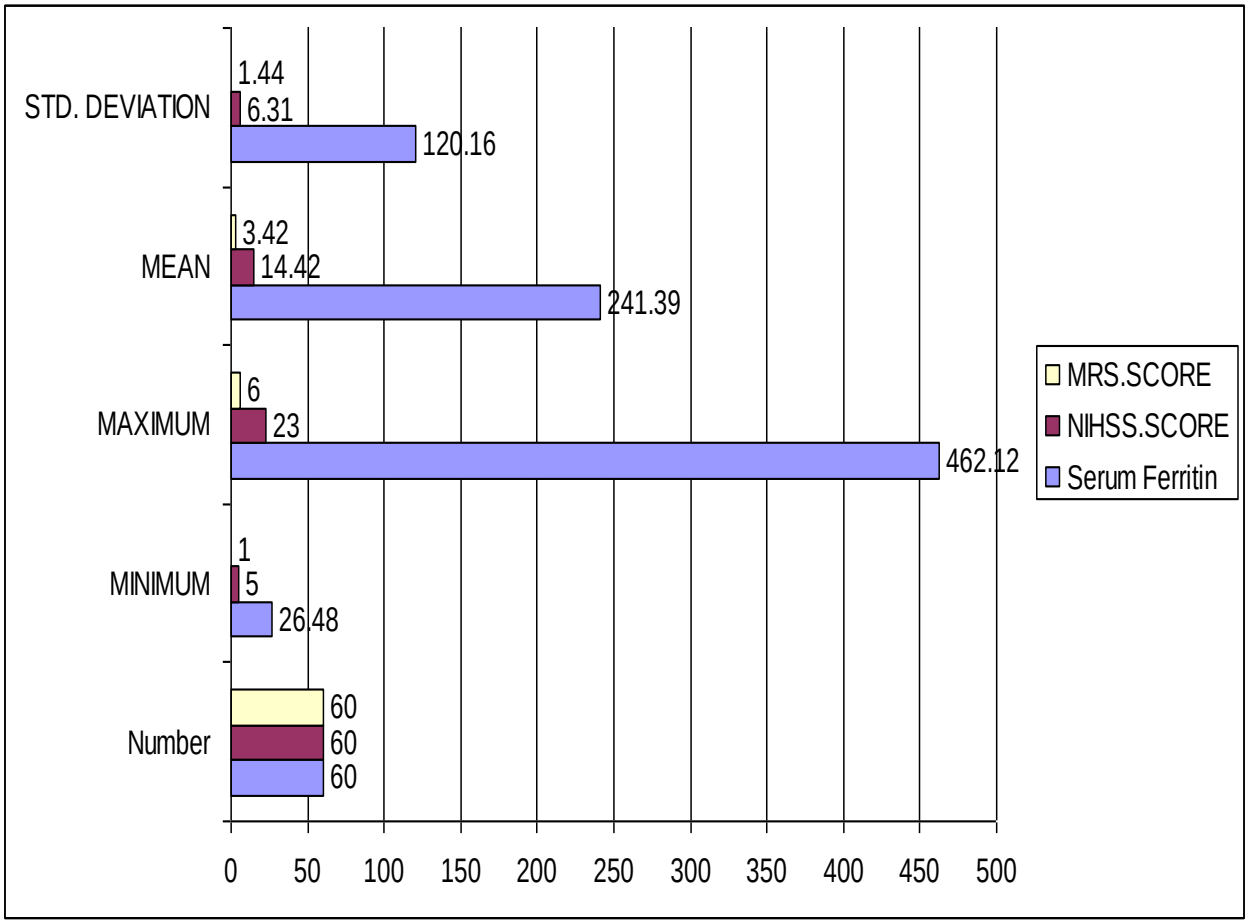
And patients withserum ferritin maximum mean value of 462.12 had

a) NIHSS maximum mean value of 23 which comes under severe category

b) MRS maximum mean value of 6 which comes under poor outcome.

TABLE 22 DESCRIPTIVE STATISTICS

VARIABLES	No.	MINIMUM	MAXIMUM	MEAN	STD. DEVIATION
SERUM FERRITIN	60	26.48	462.12	241.39	120.16
NIHSS.SCORE	60	5	23	14.42	6.31
MRS.SCORE	60	1	6	3.42	1.44



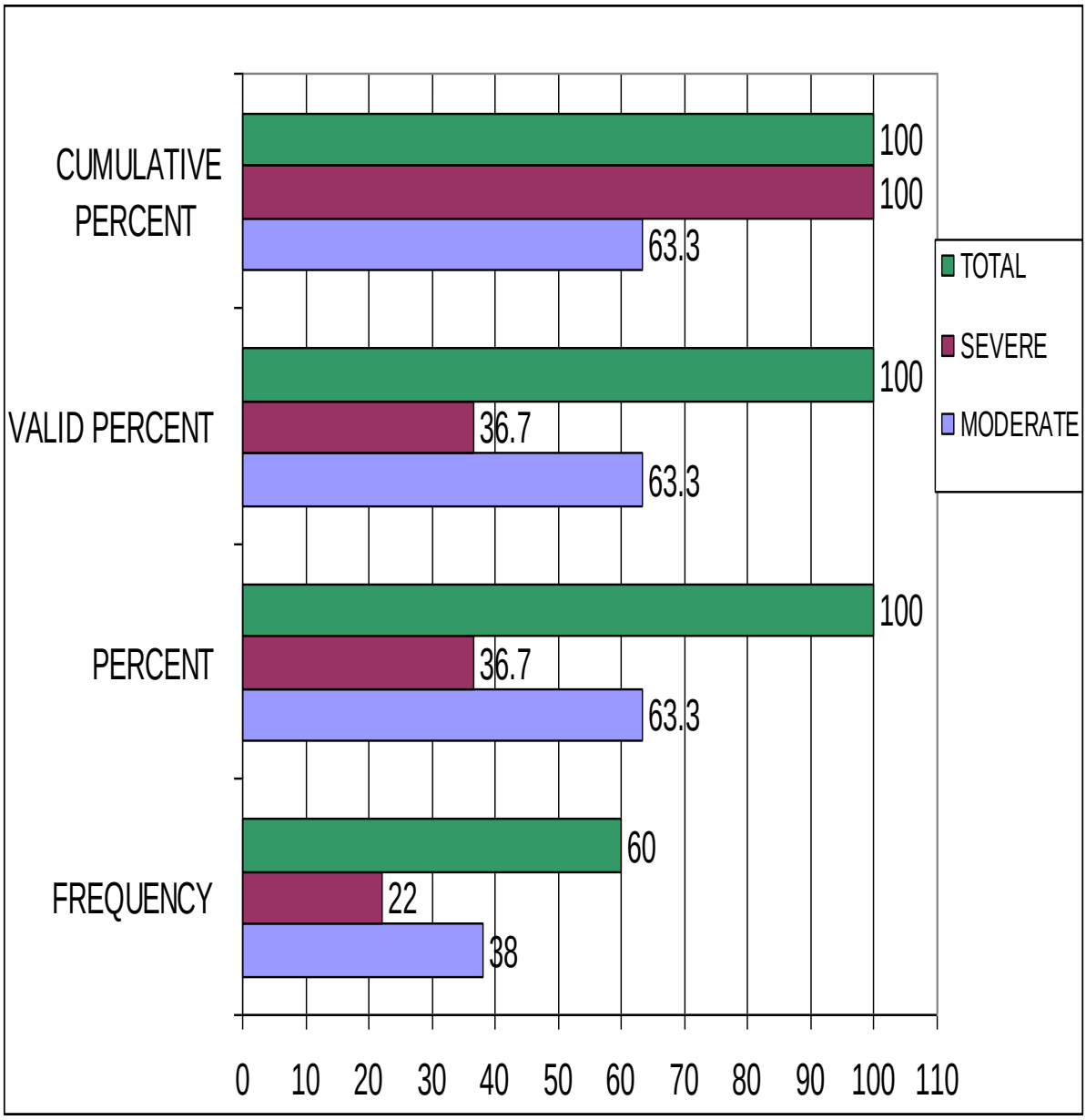
NIHSS DESCRIPTIVE STATISTICS

Out of total 60 acute ischemic stroke cases, 38 (63.33%) patients come under moderategroup of under NIHSS scoring system.

And 22 (36.67%) patients come under severity group of severe under NIHSS scoring system.

TABLE 24 NIHSS DESCRIPTIVE STATISTICS

NIHSS	FREQUENCY	PERCENT	VALID PERCENT	CUMULATIVE PERCENT
MODERATE	38	63.33	63.33	63.33
SEVERE	22	36.67	36.67	100.00
TOTAL	60	100	100	100

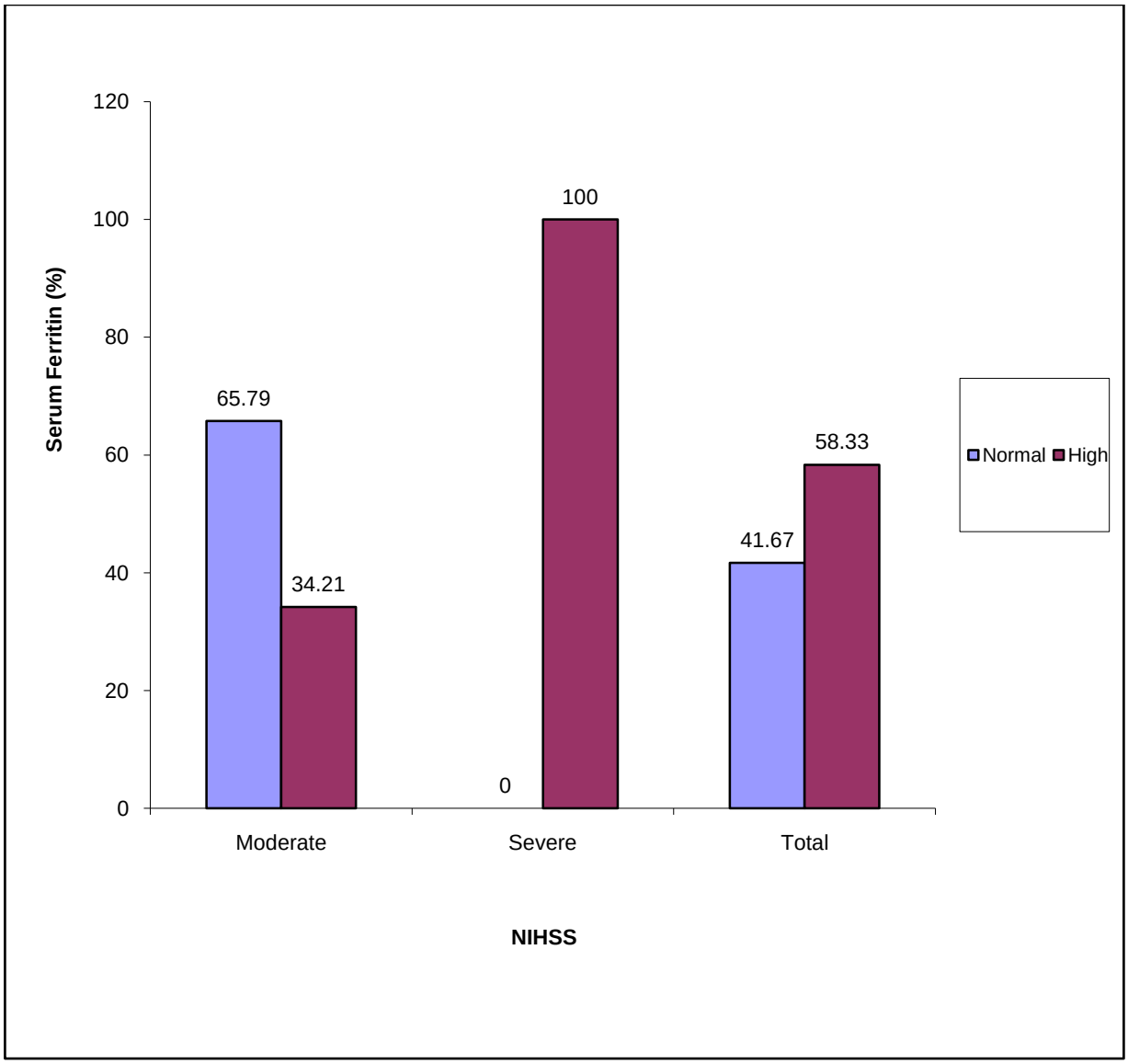

CUMULATIVE PERCENT
VALID PERCENT
PERCENT
FREQUENCY
100
100
63.3
100
36.7
63.3
100
36.7
63.3
60
22
38
TOTAL
SEVERE
MODERATE
0
10
20
30
40
50
60
70
80
90
100
110

SERUM FERRITIN vs. NIHSS

Serum ferritin profile was done in all patients and it was summated with various scoring categories of NIHSS. Out of 38 cases thatcome under moderate category in NIHSS, 25(65.79%) cases had normal serum ferritin values and 13(34.21%) cases had high serum ferritin. Out of 22 cases that were under severe category, no cases had normal serum ferritin and 22 (100%) cases had high serum ferritin.

TABLE 25SERUM FERRITIN vs. NIHSS

NIHSS	NO. OF PATIENTS	SERUM FERRITIN		TOTAL
		NORMAL	HIGH	
MILD	COUNT	0	0	00
	%	0	0	00
MODERATE	COUNT	25	13	38
	%	65.79%	34.21%	100%
SEVERE	COUNT	00	22	22
	%	00	100%	100%
TOTAL	COUNT	25	35	60
	%	41.67%	58.33%	100%


120
100
80
60
40
20
0
Serum Ferritin (%)
65.79
34.21
0
100
41.67
58.33
Normal
High
Moderate
Severe
Total
NIHSS

PEARSON'S r CORRELATION AND SCATTER PLOT ANALYSIS

This table denotes strong correlation between serum ferritin and NIHSS score. Change inserum ferritin values correlates with change in NIHSS scores.

There is also positive correlation between NIHSS score and serum ferritin , that is any increase in serum ferritin will increase NIHSS scores and decrease in serum ferritin values will decrease NIHSS scores.

TABLE 16 SERUM FERRITIN vs. NIHSS

		Serum ferritin	NIHSS
Serum ferritin	PEARSON CORRELATION	1	0.613
	P VALUE		**0.000**
	N	60	60
NIHSS	PEARSON CORRELATION	0.613	1
	P VALUE	0.000	
	N	60	60

p value = .000 **SIGNIFICANT**

There was statistically significant correlation between Serum ferritin and National Institutes of Health Stroke Scale.

PEARSON'S r CORRELATION AND SCATTER PLOT ANALYSIS

Scatterplot analysis reveals that there is a positive correlation between serum ferritin values and NIHSS scores. Increase in serum ferritin increases with NIHSS scores.

MODIFIED RANKIN SCALE

Among 60 total cases of stroke, 22 (40%) patients comes under good outcome by MRS scoring system and 38 (60%) patients comes under poor outcome by MRS scoring system.

TABLE 17 MODIFIED RANKIN SCALE DESCRIPTIVE STATISTICS

MRS	FREQUENCY	PERCENT	VALID PERCENT	CUMULATIVE PERCENT
GOOD	22	36.67	36.67	36.67
POOR	38	63.33	63.33	100.00
TOTAL	60	100	100	**100**

SERUM FERRITIN vs. MODIFIED RANKIN SCALE

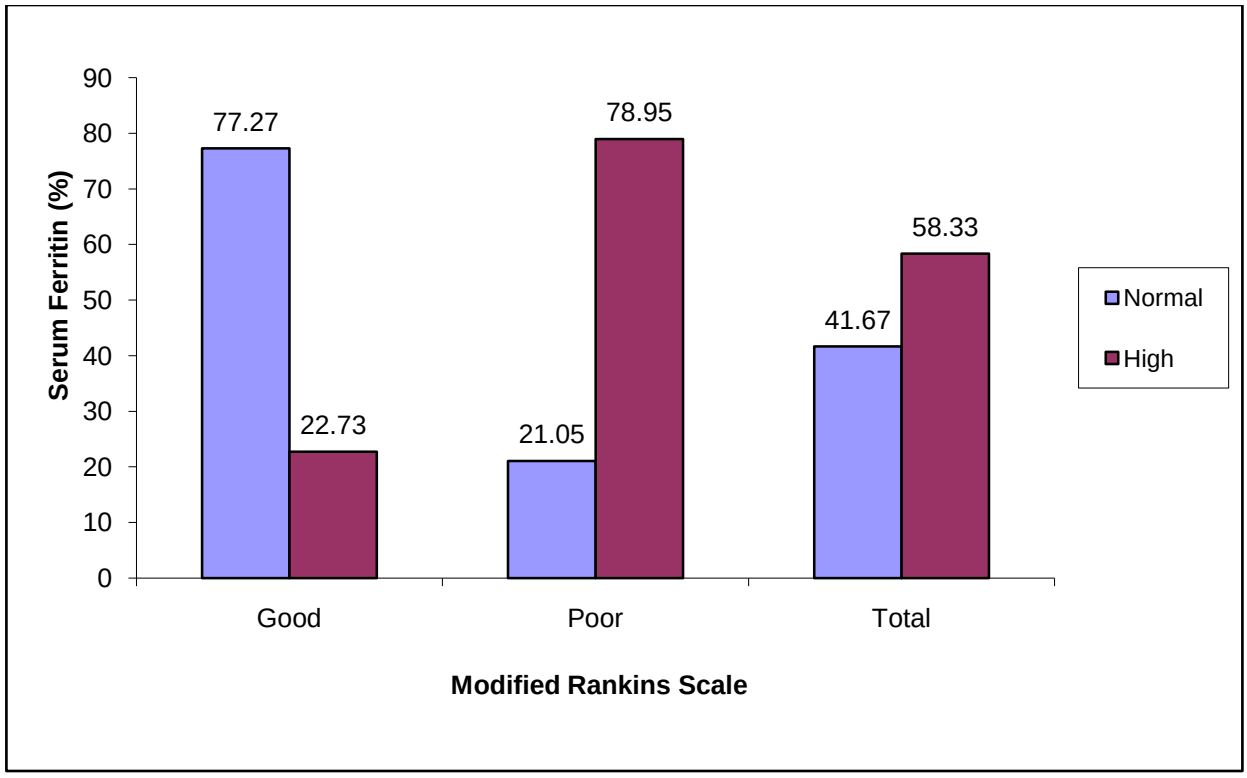
Serum ferritin values were correlated with various outcomes in Modified Rankin Scale. Among 22 good outcome patients, 17 (72.27%) cases had normal serum ferritin values and 5(27.23%) cases had high serum ferritin .

Among 38 poor outcome patients, 8 (21.05%) cases had normal serum ferritin and 30 (78.95%) cases had high serum ferritin.

TABLE 18 SREUM FERRITIN vs. MODIFIED RANKINS SCALE

MODIFIED RANKINS SCALE	NO. OF PATIENTS	SERUM FERRITIN		TOTAL
		NORMAL	HIGH	
GOOD	COUNT	17	5	22
	%	77.27%	22.73%	100%
POOR	COUNT	8	30	38
	%	21.05%	78.95%	100%
TOTAL	COUNT	25	35	60
	%	41.67%	58.33%	100%

p value = 0.000 **SIGNIFICANT**



PEARSON'S r CORRELATION AND SCATTER PLOT ANALYSIS

This table denotes correlation between serum ferritin and MRS score. Change in serum ferritin values strongly correlates with change in MRS scores.

There is also positive correlation between MRS score and serum ferritin values that are any increase in serum ferritin will increase MRS scores and decrease in serum ferritin values will decrease MRS scores.

TABLE 19 SERUM FERRITIN vs. MODIFIED RANKINS SCALE

		Serum ferritin	MRS
Serum ferritin	PEARSON CORRELATION	1	0.560
	P VALUE		**0.000**
	N	60	60
MRS	PEARSON CORRELATION	0.560	1
	P VALUE	**0.000**	
	N	60	60

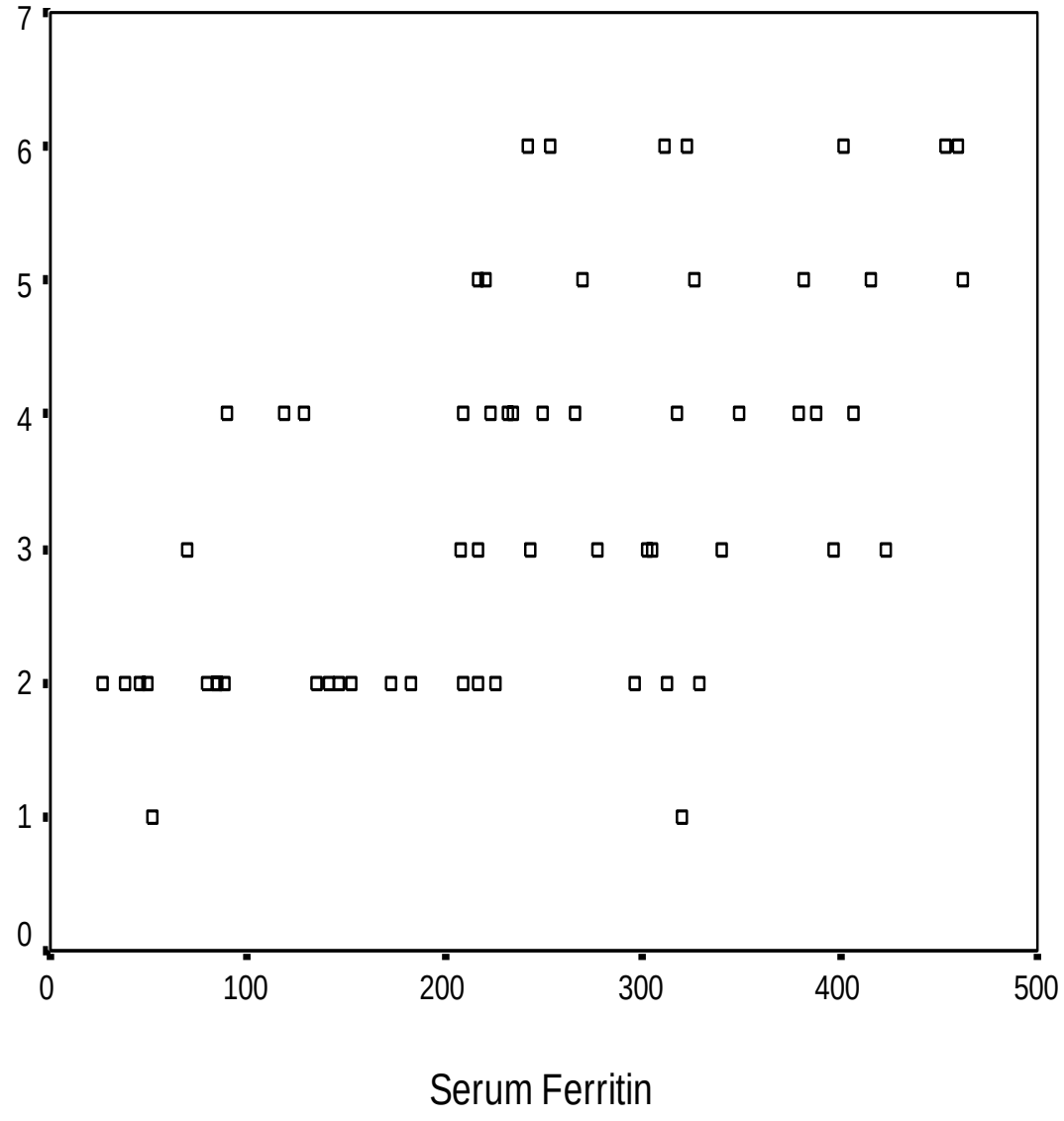
The correlation between Serum ferritin and MRS scale was statistically significant.

PEARSON'S r CORRELATION AND SCATTER PLOT ANALYSIS

Scatterplot analysis reveals that there is a positive correlation between serum ferritin Values and MRS scores. Increase in serum ferritin increases with MRS scores.

PEARSON'S r CORRELATION AND SCATTER PLOT ANALYSIS

BETWEEN SERUM FERRITIN VALUES AND MRS SCORES



DISCUSSION

Stroke is now considered as a major consequence of cerebrovascular accidents and health hazard to the society. In this study of prognostic significance of serum ferritin in Acute Ischemic Stroke consists of a group of 60 patients who were admitted in Kilpauk Medical College &Hospital,Chennaifrom March 2013 to October 2013. In this study, serum ferritin was taken within 48 hrs and NIHSS scoring was applied on the day of admission.

Totally 60 cases were included in the study. Among the 60 cases included in thisstudy cases35(58.33%) had high serum ferritin values [≥ 300 mg/l (male) , ≥200 mg/ml (female)] and 25 cases (41.67%) had normal serum ferritin [≤ 300 mg/l (male) , ≤ 200 mg/ml (female)]. Number of patients died in this group is 7. All these patients had a high serum ferritin.

Out of these 35 cases thathave high serum ferritin, 37.14% of cases come under moderate category and 62.86% cases come under severe category. On the other hand, among the remaining 25 cases who had normal serum ferritin, all the 22 cases come under moderate group and none in severe group.

Pearson's r correlation also reveals positivecorrelation between serum ferritin and NIHSS scores. Pearson's r value is 0.613. A positive correlation exists between these 2 variables with a statistically significant 'p' value.

Scatter plot analysis reveals the positive correlation between serum ferritin & NIHSS. Any increase or decrease in serum ferritin score analogous linearly with increase/decrease severity score of NIHSS.

Out of 35 cases with high serum ferritin, 5 cases were in good outcome category and 30 cases in poor outcome category of MRS scores.

In contrast among 25 cases with normal serum ferritin, 17 cases were in good outcome (MRS) and 8 cases were in poor outcome (MRS). Pearson's r correlation analysis reveals positive correlation between serum ferritin and MRS. Pearson's r value is 0.560 and is positive variable. Increase in serum ferritin will favors the poor outcome of patients in terms of death and severe disability.

Sex

In the present study, incidence of stroke in male patients is 63.33% whereas in female patients it is 36.67%. This incidence data was supported by Thomas Kuruvillet al [56]in which males has higher incidence than female. No significant relationship exists between Sex and serum ferittin in the present study. This result is against the findings of Zacharski et al.The reason for this contradiction may be small sample size (only 60 cases considered) .

Age

In the present study, incidence of stroke is more common among patient with the age group of more than 50 years. There is no significant correlation between serum ferritin and age, which was supported by study JHematolet al.

Smoking

In this present study, there is no significant correlation between serum ferritinand smoking with a p-value of 0.236. This was supported by study Salonen JT al.

Alcohol

In ourstudy there is correlation between alcohol and serum ferritin. Effect of alcohol consumption on indices of iron stores and of iron stores onalcohol intake supported byfollowing studies, which showed there is definite correlation between alcohol and Serum Ferritin.

Studies in favor of alcohol increases Serum Ferritin level

S.No	Studies	Year
1.	Leggett BA et al.	1990
2.	Milman N&Kirchhoff M	1996

Diabetes

In this present study, there is significant correlation between Serum Ferritin and diabetes with a p-value of 0.023. This was supported by number of studies.

Studies in favor of rise in blood sugar increases Serum Ferritin level

S.No	Study	Year
1.	Fernandez et al	2002
2.	Thomas MC et al	2004
3.	Kim NH et al	2000
4.	Eshed I et .al	2001

Hypertension

In this present study, there is a significant correlation between Serum Ferritin and Hypertension with a p value of0.040. These findings are in agreement with following studies.

Studies in favor of hypertension increases Serum Ferritin level

S.No	Study	Year
1.	Wrede et al	2002
2.	Piperno A et al	2002

Cholesterol

In the present study, there is a no significant correlation between serum ferritin and Serum Cholesterol level with a p value of 0.481. This findings were similar and in concordance with Halle M et al,Salonen JT et al.

This study also demonstrates the significant correlation between serum ferritin and cardiovascular risk factors such as diabetes, hypertension. Stroke is common in this risk groups and had significantly higher serum ferritin.

Ferritin and out come

This study demonstrates the prognostic significance of serum ferritin in acute ischemic stroke patients in correlation with stroke scores, which were measured at the time of admission (NIHSS) and four weeks after discharge. (MRS).Our study concludes that raised Serum Ferritin is associated withpoor prognosis. There are other studies favoring this fact.**Studies favoring Prognostic Significance of serum ferritin in Acute Ischemic Stroke are**

S.No	Studies	Year
1.	Daphne L et al	2005
2.	Davalos A et al	2000
3.	Fernandez – Real JM et al	1994
4.	Erdemoglu AK et al	2002

CONCLUSION

a.Thispresent study is a cross sectional observation study of prognostic significance of serum ferritin in acute ischemic stroke patients.

b. The present study shows male predominance with majority of patients in the age group of greater than 50 years.

c. The present study revealed significant association between serum ferritin and diabetes mellitus, hypertension & alcohol.

d. This study demonstrates the significant rise in serum ferritin in ischemic stroke patients in correlation with high scores with NIHSS which indicates the severity.

e. This study reveals the poor outcome in correlation with high serum ferritin values and good outcome in correlation with low serum ferritin values. .

f. This study shows no statistically significant relationship between serum ferritin and age, sex andsmoking.

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PROFORMA

NAME: IP NO: SERIAL NO:

AGE:

SEX:

OCCUPATION:

ADDRESS:

DATE AND TIME OF STROKE:

DATE OF ADMISSION:

STROKE: RISK FACTORS

SYSTEMIC HYPERTENSION Y/N

DIABETES MELLITUS Y/N

SMOKING Y/N

ALCOHOLISM Y/N

HIGH CHOLESTEROL Y/N

IHD Y/N

RHD Y/N

AF Y/N

PAST HISTORY OF STROKE :Y/N

CLINICAL EXAMINATION:

PULSE RATE: BP:

CVS:

RS:

ABDOMEN:

CNS:

ACUTE STROKE SYMPTOMS AND SIGNS

SYMPTOMS

HEADACHE

GIDDINESS

LOSS OF CONSCIOUSNES

VOMITING

GAIT DISTURBANCE

CONVULSIONS

SPEECH DEFICIT

SIGNS

SPEECH DEFICIT

HEMIANOPIA

DIPLOPIA

MOTOR SYSTEM

PARESIS AT ANY SITE

PARESIS OF ARMS Y/N R/L/B

PARESI OF LEGS Y/N R/L/B

PARESIS OF FACE Y/N R/L/B

FIRST INVOLVED FACE / ARMS / LEGS

NO SUCH ORDER Y/N

SENSORY DEFICIT Y/N

CEREBELLAR SIGNS Y/N

NIHSS SCORE AT THE TIME OF ADMISSION – MILD / MODERATE / SEVERE

MRS AFTER 4 WEEKS: 00/01/02/03/04/05/06

INVESTIGATIONS:

HB%:

TOTAL COUNT:

DIFFERENTIAL COUNT P- , L- , E- , M- , B-

ESR:

HS-CRP:

BLOOD UREA:

BLOOD SUGAR:

SERUM CREATININE:

SERUM ELECTROLYTES:

SERUM CHOLESTEROL:

ECG:

CT BRAIN:

HEMORRHAGE: Y/N

INFARCT: Y/N

MASTER CHART

S.NO	NAME	AGE	SEX	SMOKING	ALCOHOL	HYPERTENSION	DIABETES	CHOLESTEROL	HEMIPLEGIA		SPEECH DISTURBANCES	CRANIAL NERVE (F/V)	LOC	SERUM FERRITIN	NIHSS			MRS	
									R	L					MILD	MODERATE	SEVERE	GOOD	POOR
1	KUMARASAMY	47	M	Y	Y	Y	Y	N	Y		Y	F	N	340.16		10			3
2	PONNAMMAL	66	F	N	N	Y	Y	N	Y		Y		N	134.37		10		2	
3	KASI	72	M	Y	Y	Y	Y	N	Y			V	Y	462.12			23		5
4	SULOCHANA	48	F	N	N	N	Y	N	Y			F	N	48.91		7		2	
5	SAMPATH	44	M	Y	Y	Y	N	N		Y	Y	F	N	84.36		9		2	
6	PREMKUMAR	73	M	Y	N	Y	N	N		Y	Y	V	N	248.91		14			4
7	RATHINAM	49	F	N	N	Y	Y	Y	Y		Y		N	45.11		11		2	
8	THANGARAJ	48	M	Y	Y	N	Y	Y	Y			F	N	304.66		7			3
9	DOMADARAN	66	M	N	Y	Y	Y	Y		Y	Y	F	N	378.53			22		4
10	PAKRISAMY	53	M	Y	N	N	N	Y		Y	Y	F	N	145.61		10		2	
11	MUTHULAKSHM	63	F	N	N	N	N	N	Y		Y		N	128.51		14			4
12	SUNDARAMBAL	57	F	N	N	Y	Y	N	Y			F	N	276.52		13			3
13	GOWRI	76	F	N	N	Y	Y	Y		Y	Y	F	Y	253.51			22		6
14	SIGAMANI	54	M	Y	N	Y	N	N		Y			N	26.48		5		2	
15	VASANTHI	47	F	N	N	N	Y	Y	Y				N	224.87		6		2	
16	KANNAN	65	M	Y	N	N	Y	N		Y	Y	F	N	216.56		10		2	
17	RAMALINGAM	60	M	Y	Y	Y	Y	Y	Y			F	Y	402.12			21		6
18	ADHILAKSHMI	71	F	N	N	Y	N	N		Y	Y	F	N	216.01			22		5
19	MANIKUM	38	M	Y	Y	Y	Y	N	Y		Y	F	N	396.16		11			3
20	MARY	65	F	N	N	Y	N	Y	Y		Y	V	N	231.44			22		4
21	ARUMUGAM	53	M	Y	N	N	Y	Y	Y		Y	F	N	79.23		10		2	
22	CHANDRA	60	F	N	N	Y	Y	N	Y		Y	F	Y	220.62			23		5
23	MANI	58	M	N	Y	Y	Y	Y		Y	Y	F	N	387.43			21		4
24	RANGASAMY	74	M	N	N	Y	Y	N		Y		F	N	208.15		11			3
25	KUPPARAO	29	M	Y	Y	Y	N	Y	Y			F	N	319.32		9		1	
26	MARI	52	M	Y	N	N	N	N	Y				N	88.32		7		2	
27	JOSEPH	49	M	Y	N	N	Y	Y		Y	Y		N	328.17		6		2	
28	SARADHA	68	F	N	N	Y	Y	N		Y	Y	F	Y	241.32			23		6
29	VISWANATHAN	68	M	N	N	N	Y	N		Y		V	Y	322.71			21		6

S.NO	NAME	AGE	SEX	SMOKING	ALCOHOL	HYPERTENSION	DIABETES	CHOLESTEROL	HEMIPLEGIA		SPEECH DISTURBANCES	CRANIAL NERVE (	LOC	SERUM FERRITIN	NIHSS			MRS	
									R	L					MILD	MODERATE	SEVERE	GOOD	POOR
30	PRASAD	46	M	Y	Y	Y	Y	Y		Y	Y	F	N	423.31			23		3
31	SAROJA	72	F	N	N	Y	N	Y	Y			V	N	88.98		7			4
32	JAGANATHAN	70	M	Y	Y	N	Y	Y	Y		Y	F	N	152.58		13		2	
33	LAKSHMI	56	F	N	N	N	N	N		Y		F	N	69.82		11			3
34	SUNILPRASAD	67	M	N	Y	Y	Y	Y	Y			F	Y	415.83			23		5
35	VISHALATCHI	74	F	N	N	Y	N	Y	Y		Y	F	N	208.92			21		4
36	ELANGO	55	M	Y	N	Y	Y	N	Y				N	140.61		6		2	
37	MUNIYAMMAL	70	F	N	N	N	Y	N		Y			N	269.83			21		5
38	JAYABALAN	54	M	N	Y	N	Y	N		Y	Y	F	N	302.12		11			3
39	DINESHKUMAR	37	M	Y	Y	Y	Y	N	Y			F	N	312.18		10		2	
40	BASKAR	58	M	N	Y	Y	Y	N		Y		F	N	348.27			23		4
41	RANIYAMMAL	65	F	N	N	N	Y	N		Y			N	216.52		11			3
42	VENKATESHAN	66	M	Y	Y	Y	Y	Y		Y		F	Y	311.39			23		6
43	SELVAKUMAR	63	M	Y	Y	N	Y	Y	Y			F	N	182.43		13		2	
44	GOVINDHAN	78	M	N	Y	Y	Y	Y		Y	Y	F	N	406.51			23		4
45	SHANTHI	45	F	N	N	N	N	N	Y		Y	F	N	37.89		10		2	
46	NITHYANANDHAN	68	M	Y	Y	Y	Y	N		Y	Y	F	Y	453.58			21		6
47	MARIMUTHU	65	M	Y	N	N	Y	Y		Y	Y	F	N	296.32		7		2	
48	MUNIAPPAN	52	M	N	Y	Y	Y	Y	Y		Y		N	316.82		13			4
49	GOPAL	75	M	Y	Y	Y	Y	N	Y		Y	V	N	266.37		13			4
50	KAMALA	75	F	N	N	Y	Y	N	Y		Y	F	N	234.39			21		4
51	SENTHILKUMAR	62	M	Y	Y	Y	Y	Y		Y	Y	F	Y	381.48			22		5
52	MEERA	59	F	N	N	N	Y	Y	Y		Y		N	209.38		10		2	
53	GANESAN	70	M	Y	Y	Y	Y	N	Y		Y		Y	459.9			23		6
54	GOVINDARAJ	56	M	N	Y	N	Y	N		Y			N	172.07		7		2	
55	KARUPPIAH	72	M	Y	Y	Y	Y	N		Y	Y	F	N	242.71		14			3
56	KRISHNAVENI	62	F	N	N	Y	N	Y		Y		F	Y	118.16		14			4
57	DHANAM	38	F	N	N	N	Y	N		Y	Y	F	N	84.32		10		2	
58	DURAISAMY	76	M	N	N	Y	N	N		Y	Y	F	Y	326.47			22		5
59	GANGA	64	F	N	N	Y	Y	N	Y				N	222.79		14			4
60	RAVI	50	M	Y	N	Y	N	Y	Y				N	51.34		5		1	

Key words in master chart

M- Male

F- Female

Y-Yes

N- No

LOC- Loss Of Conscious

F-Facial Palsy (Column 10)

V-Visual Disturbances

SpDis- Speech Disturbances

ABBREVIATIONS

1. C3,C4-Complements

2. NIHSS-National Institute Of Health Stroke Scale

3. MRS-Modified Rankin Scale

4.TIA- Transient ischemic attack

5.PICH- Primary intracerebralhemorrhage

6.WHO- World Health Organization

7.ICMR- Indian Council Medical Research

8.GDP- gross domestic product

9.DALY- Disability adjusted life-year

10.UMN- Upper Motor Neuron

11.ATP-Adenosine triphosphate

12.NMDAN -methyl-D-aspartate

13.AMI- Acute myocardial infarction

13.AF-Atrial fibrillation

14.CCF- Congestive cardiac failure

15.aPTT- Activated Partial Thromboplastin Time

16. CT- Computed Tomography

17. MRI- Magnetic Resonance Imaging

18. CVA-Cerebrovascular Accidents

19. MCA-Middle Cerebral Artery

21. PCA- Posterior Cerebral Artery

22. ACA- Anterior cerebral artery

23. IHD – Ischemic heart disease

24. RHD- Rheumatic Heart Disease

25. DCM-Dilated cardiomyopathy

26. rt-PA- Recombinant Tissue Plasminogen Activator

ETHICAL CLEARANCE

INSTITUTIONAL ETHICAL COMMITTEE
GOVT.KILPAUK MEDICAL COLLEGE,
CHENNAI-10
Ref.No.1223/ME-1/Ethics/2013 Dt:07.03.2013.
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "A Study on prognostic significance of serum ferritin in patients with acute ischemic stroke" for Project work submitted by Dr. A.T.Maran, MD (GM), IInd year PG Student, Kilpauk Medical College, Chennai..

The Proposal is APPROVED.

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

19/4/13
CHAIRMAN
Ethical Committee
Govt.Kilpauk Medical College,Chennai

GOVT. KILPAUK MEDICAL COLLEGE * Kilpauk, Chennai-10. * 9 APR 2013