"A STUDY OF RED BLOOD CELL DISTRIBUTION WIDTH IN ACUTE ISCHEMIC STROKE PATIENTS- A ONE YEAR CROSS SECTIONAL STUDY AT KLE'S DR. PRABHAKAR KORE HOSPITAL AND MRC"

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ENDORSEMENT

This is to certify that the dissertation entitled **"A STUDY OF RED BLOOD CELL DISTRIBUTION WIDTH IN ACUTE ISCHEMIC STROKE PATIENTS- A ONE YEAR CROSS SECTIONAL STUDY AT KLE'S DR.PRABHAKAR KORE HOSPITAL AND MRC"** is a bonafide research work done by **(REG NO. BG0116002).**

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LIST OF ABBREVIATIONS

µmol	:	Micro mole
ACA	:	Anterior cerebral artery
ADP	:	Adenosine diphosphate
AMP	:	Adenosine monophosphate
ATP	:	Adenosine Triphosphate
AVM	:	Arteriovenous malformation
CAD	:	Coronary Artery Disease
CCA	:	Common carotid artery
cm	:	Centimeter
COPD	:	Chronic Obstructive Pulmonary Disease
CSF	:	Cerebrospinal fluid
CT Scan	:	Computed Tomography Scan
CVA	:	Cerebrovascular accident
CVD	:	Cardio Vascular disease
CVT	:	Cortico venous thrombosis
CXR	:	Chest X-ray
dl	:	Deciliter
ECA	:	External carotid artery
ECG	:	Electrocardiogram
EEG	:	Electro Encephalogram
ECVA	:	Extra Cranial Vertebral artery
ESR	:	Erythrocyte sedimentation rate
g/gm	:	Gram
HDL	:	High density lipoprotein
ICA	:	Internal carotid artery
ICVA	:	Intra Cranial Vertebral artery
Kg	:	Kilogram
L	:	Liter
LDL	:	Low density lipoprotein
LOC	:	Loss Of Consciousness
MCA	:	Middle cerebral artery
MCV	:	Mean Corpuscular Volume
MCH	:	Mean Corpuscular Hemoglobin
MCHC	:	Mean Corpuscular Hemoglobin Concentration

mg	:	Milligram
MI	:	Myocardial infarction
min	:	Minute
ml	:	Milliliter
mm	:	Millimeter
mmHg	:	Millimeter of mercury
mmol	:	Millimole
MPV	:	Mean Platelet Volume
NIHSS	:	National Institute of Health Stroke Scale
NINDS	:	National Institute of Neurological Disorders and Stroke
NMR	:	Nuclear Magnetic Resonance
MRI	:	Magnetic resonance imaging
mRS	:	Modified Rankin Score
PCA	:	Posterior cerebral artery
PICA	:	Posterior Inferior Cerebellar Artery
PoCA	:	Posterior communicating artery
RDW	:	Red Cell Distribution Width
rtPA	:	Recombinent tissue plasminogen activator
TIA	:	Transient ischaemic attack

ABSTRACT

A STUDY OF RED BLOOD CELL DISTRIBUTION WIDTH IN ACUTE ISCHEMIC STROKE PATIENTS- A ONE YEAR CROSS SECTIONAL STUDY AT KLE'S DR.PRABHAKAR KORE HOSPITAL AND MRC

BACKGROUND AND OBJECTIVES --

Red cell distribution width (RDW) is a parameter that measures variation in red blood cell size or red blood cell volume. Higher RDW has been related to poor prognosis in patients with cardiovascular disease. In stroke patients who have symptoms < 24 hours, the RDW may be useful in predicting the severity and functional outcomes of the stroke. The present study was taken up to study RDW in acute ischemic stroke patients and its correlation with severity and functional outcome.

MATERIALS AND METHODS –

A one year cross sectional study was done between January 2017 and December 2017. Patients who were diagnosed with acute ischemic stroke based on CT/MRI brain were included in this study. They were scored based on NIHSS and underwent blood investigations including RDW. At the time of discharge mRS was calculated for these patients. Statistical analysis was done to determine association of RDW with NIHSS and mRS in patients with acute ischemic stroke.

RESULTS –

In our study population it was found that 63% of the patients with acute ischemic stroke had high RDW (≥14%).Correlation of RDW with severity of stroke

as determined by NIHSS was studied using Pearson's correlation co-efficient. This study showed a positive correlation(r=0.2061) between them which was found to be statistically significant (p value = 0.0397). We also studied correlation of RDW with outcome of stroke as determined by Modified Rankin Score (mRS). We found that there was a positive correlation(r=0.4706) between RDW and mRS and this correlation was statistically significant(p value=0.0001).

INTERPRETATION AND CONCLUSION –

The study shows that higher RDW was significantly associated with severity of stroke and also with poorer functional outcome .Therefore, RDW is a strong predictor for stroke severity and disability. Further studies on a larger population are required to evaluate and validate this correlation.

KEYWORDS: Acute ischemic stroke, NIHSS, MRS, RDW

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INTRODUCTION

The WHO has defined Stroke as "rapidly developing clinical signs of focal (or global) disturbance of cerebral function with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than vascular origin"[1].

Stroke is the third leading cause of premature death globally and is associated with up to 5.54 million death every year, two thirds of which occur in developing countries[2]. According to the India stroke factsheet updated in 2012, the estimated age-adjusted prevalence rate for stroke ranges between 84/100,000 and 262/100,000 in rural and between 334/100,000 and 424/100,000 in urban areas[3]. The age adjusted annual incidence rate for stroke is 124/100000 in Rural India[4] and 145 in Urban India[5].

The mortality rate of acute stroke is as high as 27.2% (24.5% for urban and 37.1% for rural population) in acute phase[6]. Majority of stroke survivors continue to live with disabilities, and the costs of ongoing rehabilitation and long term-care are largely undertaken by family members, which impoverish their families[7].

Among risk factors for stroke assessed by multiple studies, hypertension and smoking were among the important risk factors[3,8].

Strokes are broadly categorized as ischemic or hemorrhagic. Ischemic stroke is due to occlusion of a cerebral blood vessel resulting in cerebral infarction. Ischemic strokes are classified by the following underlying cause for the vascular occlusion: 1. atherosclerosis with superimposed thrombosis affecting large cerebral or extra-

cerebral blood vessels, 2. cerebral embolism, and 3. occlusion of small cerebral vessels within the parenchyma of brain[9].

The neurological impairment associated with stroke is usually assessed by National Institute of Health Stroke Scale (NIHSS)[10] and the outcome is assessed by using Modified Rankin Scale (mRS)[11].

Recently, several studies have claimed that red cell distribution width (RDW) is a good independent predictor of severity and outcome in stroke [12,13].

So RDW will be a simple inexpensive biomarker for the assessment of the severity and functional outcome of stroke, since RDW is a routine hematological parameter detected easily by most modern automated counters.

On the other hand Ntaios et al found that Red Cell Distribution Width does not predict stroke severity or functional outcome[14]. The association between red cell distribution width and acute ischemic stroke is not well established with contradictory results coming from different studies.

The present study was taken up to study RDW in acute ischemic stroke patients and its correlation with severity and functional outcome of ischemic stroke patients.

AIMS AND OBJECTIVES

1. To study red blood cell distribution width in acute ischemic stroke patients.

2. To correlate red blood cell distribution width with severity of acute ischemic stroke as assessed by National Institutes of Health Stroke Scale (NIHSS).

3. To correlate red blood cell distribution width with outcome of acute ischemic stroke as assessed by Modified Rankin Scale (mRS).

REVIEW OF LITERATURE

The first recorded reference to the nervous system was seen in work of The Edwin Smith Surgical Papyrus, composed circa 3500 BC, which contains the first use of the word ‘brain’ along with a description of its coverings and the fluid beneath them[15].

It was Hippocrates (The father of medicine) who first recognized stroke over 2400 years ago. As it was noted that the affected person developed sudden paralysis and change in wellbeing, the term 'apoplexy' was coined which means' struck down by violence'[15]. Hippocrates had noted that ‘Unaccustomed attacks of numbness and anesthesia are signs of impending apoplexy’, a description of a transient ischemic attack.

Initially apoplexy was explained according to humoral theory, as the balance between the four humors: blood, phlegm, black bile, and yellow bile. Apoplexy was often attributed to an accumulation of black bile in the brain arteries, obstructing the passage of animated spirits from the ventricles[16].

It was the work of W.Harvey (1578-1657)entitled Exercitatioanatomica de motu cordiset sanguinis in animalibus(De motu cordis)[17] which first correctly described in exact detail how the blood is pumped around the body by the heart, then returned to the heart and recirculated in the circulatory system. This description formed the foundation for the recognition of the role of blood vessels in the pathogenesis of stroke.

The link between the conditions of the arteries and parenchymatous lesions was found by Johann Jacob Wepfer(17 century)when he saw his patients who died from apoplexy had bleeding in the brain[18].

It was Chiari in 1905 who described the possible association of carotid artery disease and stroke. Chiari upon studying a series of 400 patients suggested that embolic material could break away from the plaques of carotid artery and affect the brain, causing stroke. He later proposed that occlusive disease of the extracranial vessels could be responsible for neurological symptoms.

By 1950s and 1960s thrombosis and insufficiency of the carotid and vertebral arteries had been described often in medical literature[19].

Godfrey Hounsefieldin 1972 invented CT scan and which revolutionized the diagnosis and treatment of stroke[20].In 1973, it was the work of Poul Lauterbur which made the first nuclear magnetic resonance (NMR) possible. Later the name was changed to the new universally accepted magnetic resonance imaging (MRI)[20].

EPIDEMIOLOGY

Stroke is becoming an important cause of premature death and disability in low-income and middle-income countries like India, largely because of demographic changes and the increasing prevalence of the many modifiable risk factors. The poor are increasingly affected by stroke, because of the changing population exposures to risk factors and high cost for stroke care. Majority of stroke survivors continue to live with disabilities, and the costs of ongoing rehabilitation and long term-care are largely undertaken by family members, causing financial and psychological burden to them[3].

The four leading chronic diseases in India, according to their prevalence are: (1) Cardiovascular diseases (CVDs), (2) Diabetes mellitus, (3) Chronic obstructive pulmonary disease(COPD) and (4) Cancer.

In India, stroke incidence registries using population-based surveillance have reported that age adjusted annual incidence of stroke varies from 100- 150/100,000 population[21]. The overall annual incidence rates are available only from few regions in the country; the rates per 100000 population varied from 13 in Vellore[22]33 in Rohtak[23]to 36/100000 in Kolkata[24]. Approximately 12% of all strokes occur in the population <40 years of age. There has been an increase in the number of stroke cases in India during the last one and a half decades by17.5 %. In 2000–08, the overall stroke incidence rates in low to middle income countries have, for the first time, exceeded the level of stroke incidence seen in high-income countries, by 20%[25].

Pooled analysis through forecasting method has shown that the estimated prevalence rates of stroke for the years 2000 and 2015 are 108 and 133 per 100,00 population, respectively, indicating a dramatic rise in prevalence of stroke over a period of 15 years, and by 2015 it is estimated that there will be 1,667,372 cases of stroke in India[26]. The prevalence rates are similar to other developing countries[27].

The increase in CHD and stroke in India is largely an urban phenomenon. In 2005, estimates indicated that 58 million people died, and in them chronic diseases accounted for nearly 35 million deaths(60%). Cardiovascular diseases, predominantly heart disease and stroke, were the cause of death in 17·5 million individuals. After heart disease, stroke is the second leading single cause of death, with 5·8 million fatal cases per year, 40%of which are in people younger than 70 years[28]. Mortality due to strokes has increased by 7.8% from 1998 to 2004[28].

Blood supply of the Brain

The brain is supplied by the

1. Two internal carotid arteries
2. Two vertebral arteries.

Internal Carotid Artery

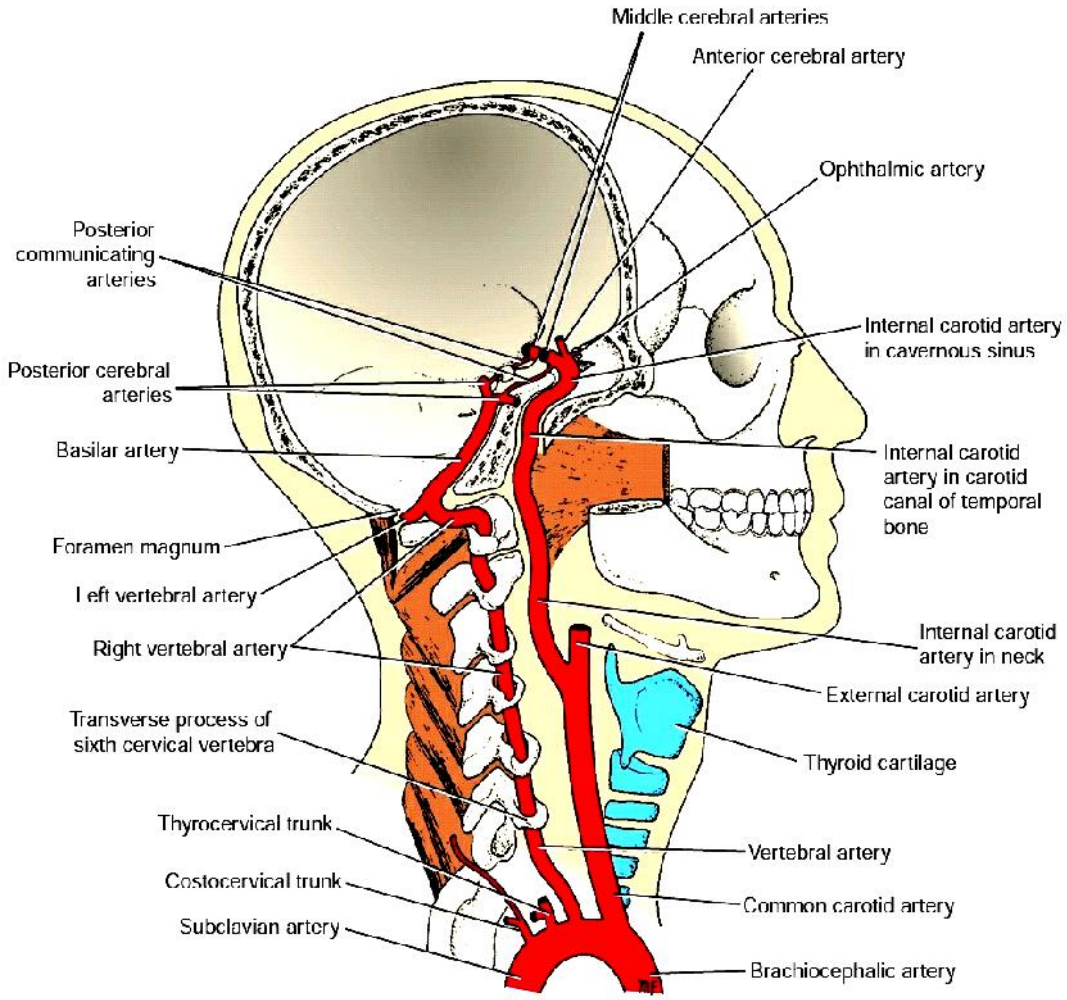


Fig 3.1: Origin and course of ICA and Vertebral artery

The carotid system consists of:

1. The common carotid,
2. Internal carotid, and
3. External carotid.

The right common carotid artery arises from the brachiocephalic artery and the left common carotid arises from the aortic arch. The common carotid arteries ascend in the neck and at the angle of jaw (at the level of C4) divides into external carotid artery and internal carotid artery[9].

The internal carotid artery then ascends and enters the cranial cavity through the carotid canal where it divides into the anterior and middle cerebral arteries[29] at medial end of the lateral cerebral sulcus.

Table 3.1: Branches of intracranial portion of internal carotid artery.

	ARTERY	COURSE	AREA OF SUPPLY
1	Ophthalmic artery	Arises from the internal carotid artery after it emerges from the cavernous sinus. It enters the orbit through the optic canal below and lateral to the optic nerve.	It supplies the eye and other orbital structures. Its terminal branches supply the frontal area of the scalp, the ethmoid and frontal sinuses, and the dorsum of the nose.
2	Posterior communicating artery	Originates from the internal carotid artery close to its terminal bifurcation. The posterior communicating artery runs posteriorly to join the posterior cerebral artery, to form part of the circle of Willis	
3	Anterior choroidal artery	Originates from the internal carotid artery just before its bifurcation.	It supplies the optic tract, choroid plexus of the lateral ventricle, hippocampus and some of the deep structures of the hemisphere including the internal capsule and globus pallidius.
4	Anterior cerebral artery	It's a smaller terminal branch of the internal carotid artery. It runs forward and medially superior to the optic nerve and enters the longitudinal fissure of the cerebrum. Here, it is joined to the anterior cerebral artery of the opposite side by the anterior communicating artery. It curves backward over the corpus callosum to anastomose with the posterior cerebral artery.	Cortical branches: supplies the medial surface of the cerebral cortex as far back as the parietooccipital sulcus. They also supply a strip of cortex about 1 inch (2.5 cm) wide on the adjoining lateral surface. The anterior cerebral artery thus supplies the "leg area" of the precentral gyrus
			Central branches: supply parts of the lentiform and caudate nuclei and the internal capsule.
5	Middle cerebral artery	Larger terminal branch of the internal carotid runs laterally in the lateral cerebral sulcus	Cortical branches supply the entire lateral surface of the hemisphere, except for the narrow strip (anterior cerebral artery), the occipital pole, and the inferolateral surface of the hemisphere (posterior cerebral artery). This artery thus supplies all the motor area except the "leg area"
			Central branches supply the lentiform and caudate nuclei and the internal capsule

Vertebral Artery

The vertebral artery branches off from the first part of the subclavian artery. It ascends the neck by passing through the foramina in the transverse processes of the upper six cervical vertebrae. It enters the skull through the foramen magnum. The two vertebral arteries from either side join at the lower border of the pons to form the basilar artery.

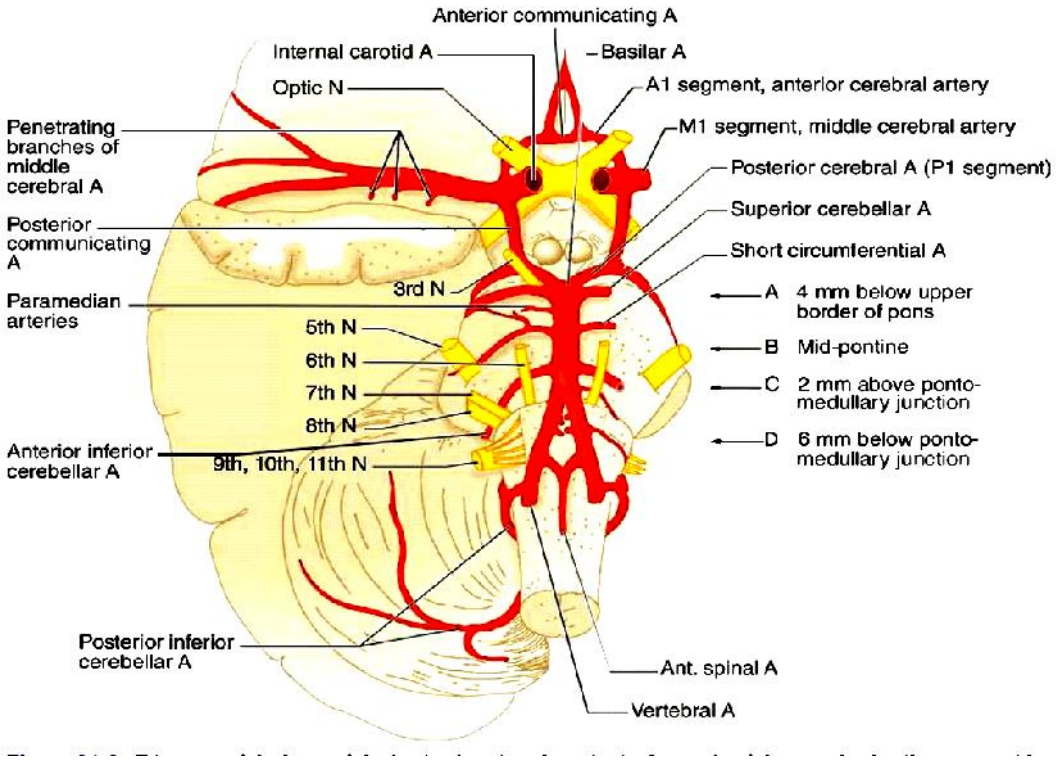


Fig 3.2: Arteries of the inferior surface of the brain

Table 3.2: Branches of intracranial portion of vertebral artery

	ARTERY	COURSE	AREA OF SUPPLY
1	Meningeal branches		Supplies bone and dura in the posterior cranial fossa.
2	Posterior spinal artery	Arises from the vertebral artery or the posterior inferior cerebellar artery. It descends on the posterior surface of the spinal cord close to the posterior roots of the spinal nerves.	Supplies the grey and white posterior columns of the spinal cord
3	Anterior spinal artery	This single artery descends on the anterior surface of the medulla oblongata and spinal cord and is embedded in the piamater along the anterior median fissure	Supplies the anterior portion of the spinal cord. it is reinforced by several contributory arteries, especially the artery of Adamkiewicz.
4	Posterior inferior cerebellar artery	The largest branch of the vertebral artery passes on an irregular course between the medulla and the cerebellum.	It supplies the inferior surface of the vermis, the central nuclei of the cerebellum, and the undersurface of the cerebellar hemisphere; it also supplies the medulla oblongata and the choroid plexus of the fourth ventricle.
5	Medullary arteries		Supplies the medulla oblongata

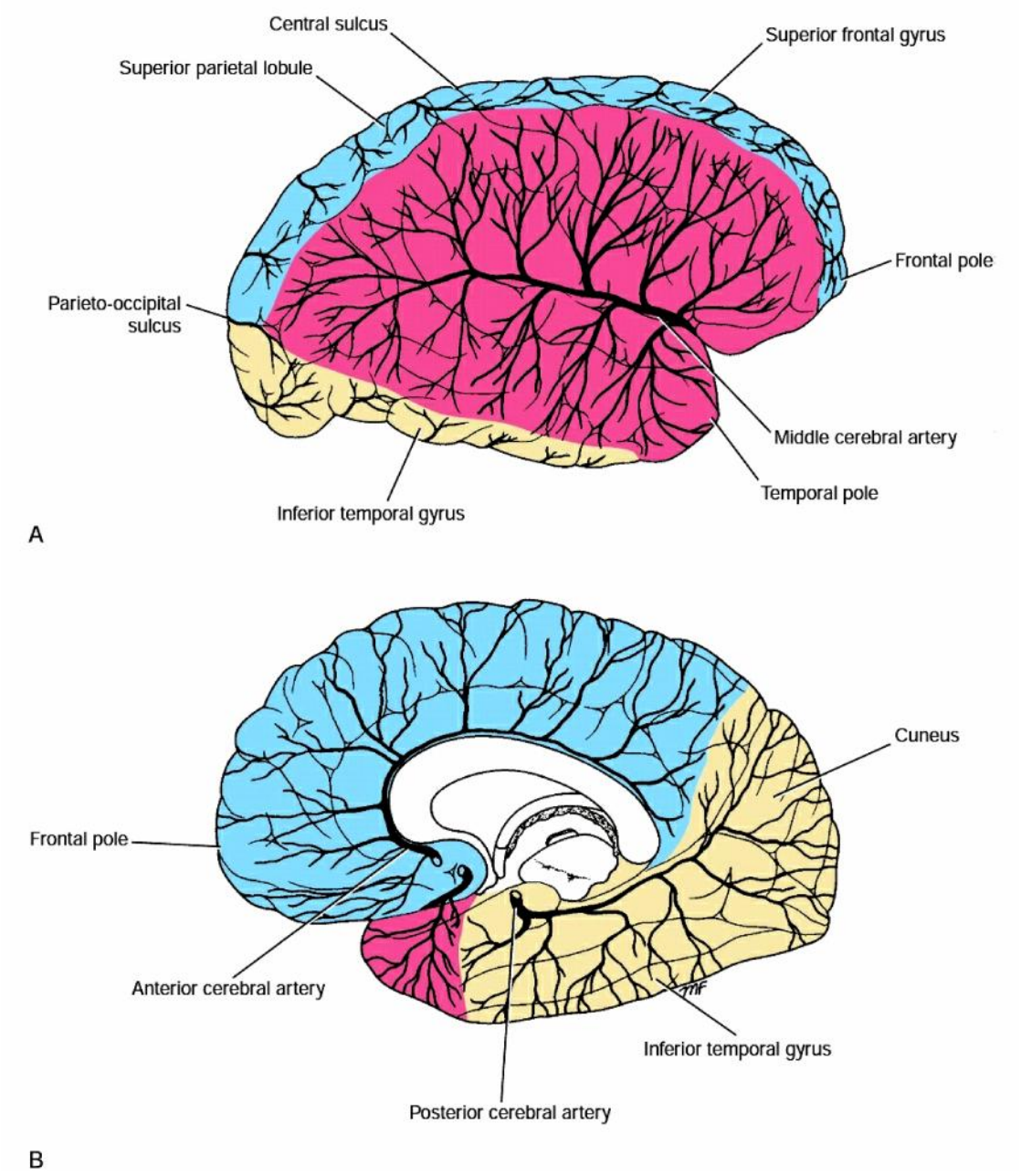


Fig 3.3: Areas supplied by the cerebral arteries. A: Lateral surface. B: Medial surface. Area supplied by ACA is coloured blur, the area supplied by MCA is coloured pink and the area supplied by PCA is coloured cream.

Basilar Artery

As explained above the basilar artery is formed by the union of the two vertebral arteries at the lower border of pons. It ascends in a groove on the anterior surface of the pons. At the upper border of the pons, it divides into the two posterior cerebral arteries.

Table 3.3: Branches of basilar artery

	ARTERY	COURSE	AREA OF SUPPLY
1	Pontine arteries		Supplies the pons
2	Labyrinthine artery	Long, narrow artery that accompanies the facial and the vestibulocochlear nerves into the internal acoustic meatus. often arises as a branch of the anterior inferior cerebellar artery.	Supplies the internal ear
3	Anterior inferior cerebellar artery	Arises from the basilar artery at the level of junction between pons and medulla oblongata.	Supplies the anterior and inferior parts of the cerebellum. A few branches pass to the pons and the upper part of the medulla oblongata.
4	Superior cerebellar artery	Arises close to the termination of the basilar artery. It winds around the cerebral peduncle	Supplies the superior surface of the cerebellum. It also supplies the pons, the pineal gland, and the superior medullary velum.
5	Posterior cerebral artery	Begins where posterior communicating artery and basilar artery join. It then curves laterally and backward around the midbrain.	Cortical branches supply the inferolateral and medial surfaces of the temporal lobe and the lateral and medial surfaces of the occipital lobe. Thus, the posterior cerebral artery supplies the visual cortex.
			Central branches pierce the brain substance and supply parts of the thalamus and the lentiform nucleus as well as the midbrain, the pineal, and the medial geniculate bodies.
			A choroidal branch enters the inferior horn of the lateral ventricle and supplies the choroid plexus; it also supplies the choroid plexus of the third ventricle.

Circle of Willis

The two internal carotid arteries and the two vertebral arteries anastomose at the base of the brain to form the circle of Willis. The anterior communicating, anterior cerebral, internal carotid, posterior communicating, posterior cerebral, and basilar arteries all contribute to the circle. The circle of Willis allows blood that enters by either ICA or vertebral arteries to be distributed to whole of the brain. Cortical and central branches arise from the circle and supply the brain substance. Variations in the sizes of the arteries forming the circle are common with the absence of one or both posterior communicating arteries having been reported.

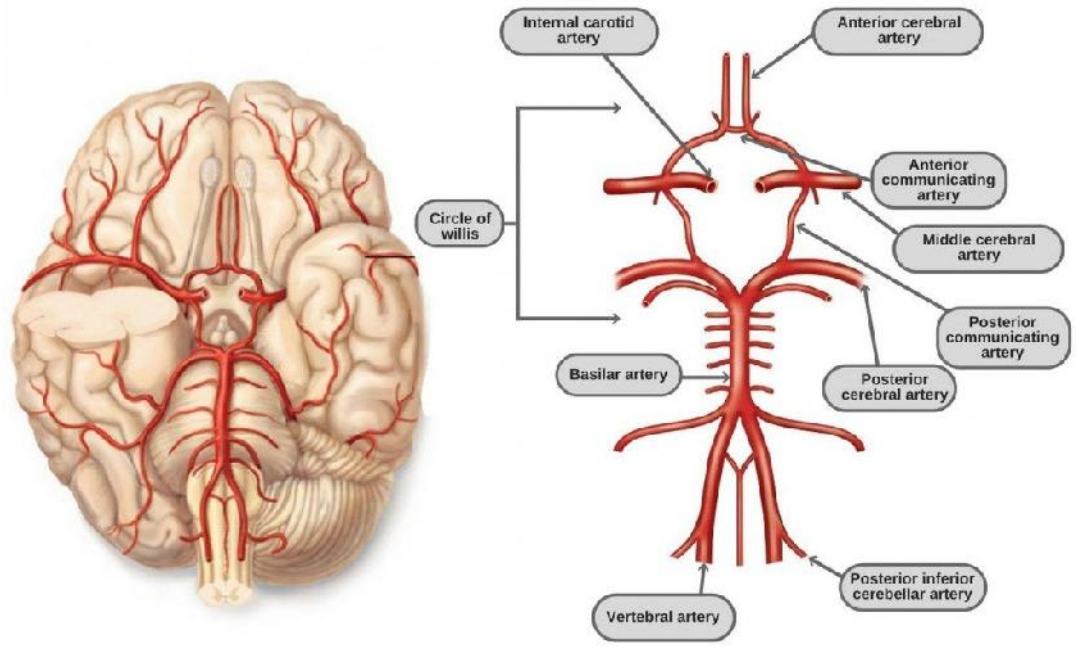


Fig 3.4: Circle of Willis

Table 3.4: Arteries to specific areas of brain

	SPECIFIC AREAS	ARTERIES
1	Corpus striatum and the internal capsule	Medial and lateral striate central branches of the middle cerebral artery; the central branches of the anterior cerebral artery supply the remainder of these structures.
2	Thalamus	By branches of the posterior communicating, basilar and posterior cerebral arteries.
3	Midbrain	Posterior cerebral, superior cerebellar, and basilar arteries.
4	Pons	Basilar and the anterior, inferior, and superior cerebellar arteries.
5	Medulla oblongata	Vertebral, anterior and posterior spinal, posterior inferior cerebellar, and basilar arteries.
6	Cerebellum	Superior cerebellar, anterior inferior cerebellar, and posterior inferior cerebellar arteries

PATHOPHYSIOLOGY

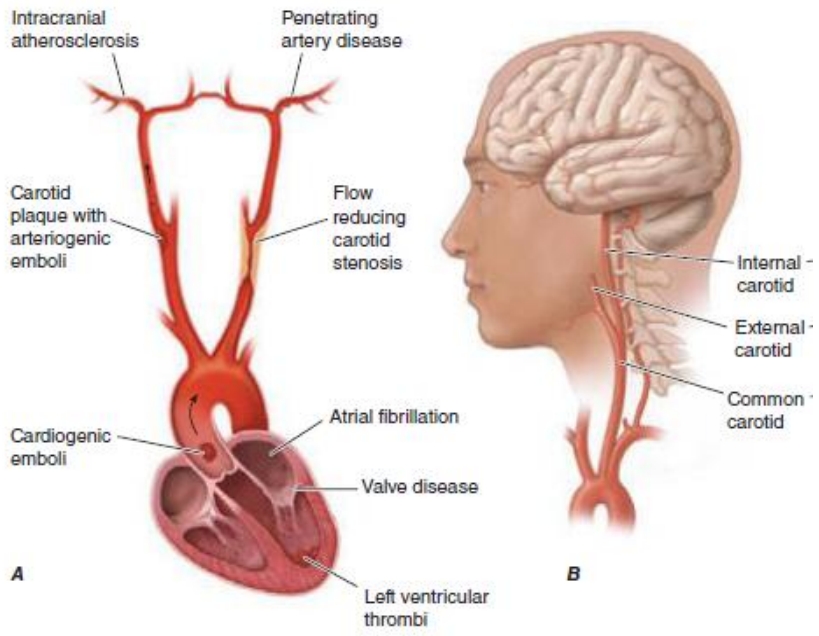


Fig 3.5: Pathophysiology of ischemic stroke

Two causes of ischemic stroke stand out:

1. atherosclerotic-thrombotic disease of the cerebral or extra-cerebral vessels, and
2. cerebral embolism.

Irrespective of the etiology, reduced vascular supply to the brain is the primary event in majority of acute strokes.

Immediately after an ischemic event, the centre of the core is perfused at 10–12 ml/100 g/min or less, while the ischemic area around it (surrounded by the penumbra) is critically hypo-perfused at less than 18–20 ml/100 g/min and is at risk of dying within hours. In contrast, the penumbra is perfused at approximately 60 ml/100 g/min and is less likely to die[30].Neurons in the penumbra are mostly dysfunctional but may recover if reperfused in time.

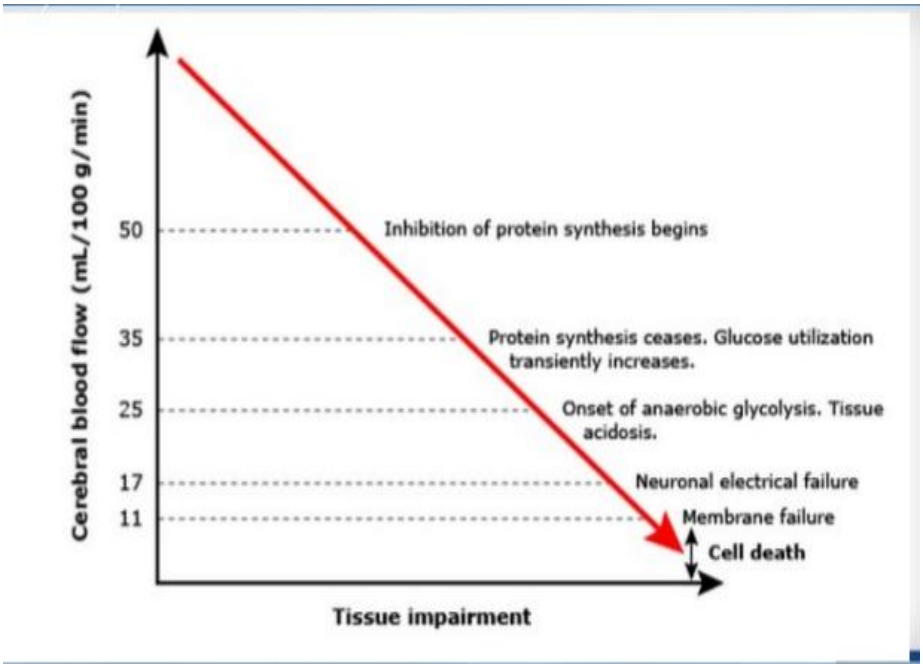


Fig 3.6: Effects of decreased cerebral blood flow on vital brain functions

Low respiratory reserve and complete dependence on aerobic metabolism make the brain tissue vulnerable to effects of ischemia. A spectrum of severity is generally seen in the affected region of the brain, due to the presence of collateral circulation. Thus, part of the brain parenchyma (core) undergoes immediate death, while others may only be partially injured with potential to recover(penumbra)[31]. Ischemia causes brain damage by local depletion of oxygen or glucose, causing failure of production of high energy phosphate compounds, like adenosine triphosphate (ATP). This adversely affects energy-dependent processes necessary for tissue cellsurvival, setting off a series of interrelated events resulting in cellular injury and death.

The possible sequence of events in cerebral ischemia are:

1. Depletion of ATP
2. Sodium, potassium, calcium ionic concentration changes
3. Acidosis due to increased amount of oxygen free radicals and proteolytic enzymes
4. Accumulation of water inside the cell

In ischemic stroke two types of edema can occur: Cytotoxic edema and Vasogenic edema.

Cytotoxic edema: Due to ischemia, there will be failure of energy dependent pumping system of sodium and calcium, which will lead to accumulation of water inside the cells resulting in cerebral edema. Cytotoxic edema implies large volume of dying or dead cells implies poor outcome.

Vasogenic edema**:** The blood brain barrier breakdown occurs, resulting in leakage of osmotically active substance from intravascular to interstitial space which results in increased extracellular fluid volume. It does not necessarily imply neuronal injury and this extravascular fluid can be mobilized and removed. About 10% of ischemic stroke is massive because of this cerebral edema which may be severe to produce increased intracranial tension and herniation.

The vasculature of the human central nervous system has unique features intended to preserve blood flow to critical brain structures. Ostensibly, a high-flow, low-pressure fluid perfusion system, the networks of micro vessels of the cortex and striatum allow for reversal of flow should microvascular obstructions occur[31].

The cerebrovascular endothelium performs complex functions as a regulator of hemostasis and inflammation and as a gatekeeper of the microcirculation[33]. Under normal circumstances the endothelium presents to the blood an actively antithrombotic and anti-inflammatory surface[34].

Risk factors for stroke such as advanced age, diabetes, hypercholesterolemia, and other conditions that predispose to brain infarction may operate to increase stroke likelihood by altering the luminal surface of the endothelium.

Cerebral thromboemboli arise from cardiac sources (e.g., ventricular mural thrombi, valvular sources, the atria during atrial fibrillation, and cryptogenic origin), sites of arterial and aortic atherosclerosis, in situ thrombi (e.g., predilection sites within the intracranial circulation, and associated with vasculitis), or microvascular sources. Thromboemboli arising from atheromata underlie 40–57%of ischemic

strokes. Predilection sites for atheromata include the aortic arch, the carotid artery bifurcation, portions of the internal carotid artery and the proximal MCA.

In situ thrombosis may occur on atheromata within cerebral circulation (the mid-segment of the basilar artery), leading to focal ischemia, where collateral protection is compromised or absent. Lacunar infarction follows fibrinoid deposits within arterioles serving the stricken tissue, often in the setting of sustainedhypertension[34].

RISK FACTORS

Non modifiable:

- **Age:** The risk increases with age, the incidence doubling with each decade after the age of 45, and more than 70% of all strokes occur in people aged 65 and older[35].
- **Gender:** Age-adjusted incidence rates of ischemic stroke due to large-vessel cervical or intracranial atherosclerosis with stenosis were nearly 4 times higher (*P*,0.0001) for men (47.3 per 100 000) than for women (11.9 per 100 000)[36].
- **Race:** Atherosclerosis is, in most cases, affecting the intracranial vasculature and is suggested to be the most common cause of stroke in Asians[37].
- **Heredity**: found that a positive family history of stroke and IHD was significantly more common in patients with stroke than in the general population[38].

Modifiable:

- Previous vascular event: Hypertension was the strongest risk factor for stroke and was stronger for intracerebral hemorrhagic stroke than for ischemic stroke[39].
- Diabetes Mellitus: Self-reported history of diabetes mellitus was associated with an increased risk of all stroke and ischemic stroke, but not intracerebral hemorrhagic stroke.
- Anthropometry: Body -mass index was not associated with stroke whereas waist-to-hip ratio was associated with increased risk of all stroke, and both ischemic and intracerebral hemorrhagic stroke[39].
- Diet: Increased consumption of fruit and fish was associated with reduced risk whereas increased consumption of red meat, organ meats, or eggs; increased consumption of fried foods, pizza, or salty snacks; and cooking with lard resulted in increased risk for stroke[39].
- Physical activity: Regular physical activity was associated with a reduced risk of both ischemic and hemorrhagic stroke as it exerts a beneficial protective effect on reduction as well as recurrence of stroke throughout life, including in older adults[40-43].
- Stress: Psychosocial stress was associated with an increased risk of all stroke, with consistent estimates for ischemic and intracerebral hemorrhagic stroke.
- Smoking: Current smoking status (*vs* never or former) was associated with an increased risk of stroke, which seemed to be stronger for ischemic stroke than for intracerebral hemorrhagic stroke[39].
- Alcohol: A history of alcohol intake of more than 30 drinks per month was associated with an increased risk of ischemic stroke.

- Atrial fibrillation: Was the most important risk factor for ischemic stroke as a cardiac source of thromboembolism.

Increased concentration of total cholesterol was not associated with risk of ischemic stroke but was associated with reduced risk of intracerebral hemorrhagic stroke[39]. Increased concentration of HDL cholesterol was associated with a reduced risk of ischemic stroke, but an increased risk of intracerebral hemorrhagic stroke.

STROKE SYNDROMES

The clinical features resulting from an occlusion of any one artery show sufficient uniformity from one patient to another to justify the assignment of a typical syndrome to each of the major cerebral arteries and their branches.

The distinction between vascular occlusion from a local atherosclerotic plaque with superimposed thrombosis and an embolic occlusion is made largely based on following factors:

1. The temporal profile of the stroke syndrome, an immediate stroke favouringembolus, and a slowly evolving or "stuttering" onset or early morning strokefavouringatherosclerosis, and
2. Associated medical risk factors such as atrial fibrillation, valvular heart diseases (strongly favoring embolus) or diabetes, hypertension, TIA, hyperlipidemia and smoking, together favoring atherosclerosis of the small penetrating or large trunk vessels.

Carotid Artery Syndromes

The carotid system consists of three major arteries on either side: the common carotid, internal carotid, and external carotid. The carotid vessels are subject to

atherosclerotic narrowing, atherothrombotic occlusion, arterial dissection and rarely, other processes such as various forms of vasculitis.

Occlusion of the common carotid artery accounts for not more than 1 percent of cases of carotid artery syndrome. Most of the carotid artery syndrome is because of the internal carotid artery lesions. Nevertheless, the common carotid can be occluded by an atheromatous plaque at its origin in the thorax, more often on the left side. Atherosclerotic stenosis or occlusion of the midportion of the common carotid is usually seen post-radiation therapy for head and neck cancer

Table 3.5: Symptoms and signs of internal carotid artery disease

SYMPTOMS OF INTERNAL CAROTID ARTERY DISEASE	**SIGNS OF INTERNAL CAROTID ARTERY DISEASE**
1. Attacks of transient monocular blindness 2. Transient ischemic attacks, sometimes variegated, and occurring during a span of weeks or months 3. Frequent, unaccustomed headache 4. Commonly associated history of coronary or peripheral vascular disease	**Neck** 1. High-pitched, focal, long bruit at bifurcation **Face** 2. Increased angular, brow, cheek (ABC) pulses[44], Frontal artery sign [45] 3. Increase in superficial temporal artery pulse **Retina** 4. Cholesterol crystals [46] 5. Platelet plugs [47] 6. Retinal infarcts 7. Reduced calibre of arteries 8. Less severe hypertensive changes 9. Venous stasis retinopathy[48,49] 10. Reduced retinal artery pressure

Occlusion of the first part of the internal carotid artery i.e. immediately beyond the carotid bifurcation, may be silent (30 to 40 percent of cases).If one internal carotid artery had been occluded at an earlier time, occlusion of the other may cause bilateral cerebral infarction. The clinical effects in such cases may include coma with quadriplegia and continuous horizontal "metronomic" conjugate eye movements. Occlusion of the distal intracranial portion of the internal carotid artery produces a clinical picture like that of middle cerebral artery occlusion: contralateral hemiplegia, hemi hypesthesia, and aphasia (when dominant hemisphere is involved).

Headache, located as a rule above the eyebrow, on the side of the infarction, may occur with thrombosis or embolism of the carotid artery. The headache associated with occlusion of the middle cerebral artery tends to be more lateral, at the temple and that of posterior cerebral occlusion is located in or behind the eye.

The internal carotid artery also nourishes the optic nerve and retina. For this reason, transient monocular blindness occurs prior to the onset of stroke in 10 to 25 percent of cases of symptomatic carotid occlusion.

Signs of carotid occlusion include transient monocular blindness or visual loss or dimness of vision with exercise, after exposure to bright light, or on assuming an upright position; retinal atrophy and pigmentation; atrophy of the iris; peripapillary arteriovenous anastomoses in the retinae; and claudication of jaw muscles.

Middle Cerebral Artery Stroke Syndromes

Table 3.6: Middle cerebral artery stroke syndromes

ARTERY OCCLUDED	CLINICAL MANIFESTATIONS
Entire Territory	Contralateral gaze palsy, hemiplegia, hemisensory loss, spatial neglect, hemianopsia, global aphasia (if on left side). May lead to coma secondary to edema
Deep	Contralateral hemiplegia, hemisensory loss, transcortical motor and/or sensory aphasia (if on left side).
Parasylvian	Contralateral weakness and sensory loss of face and hand. Conduction aphasia, apraxia and Gerstmann syndrome (if on left side) Constructional dyspraxia (if on right side).
Superior Division	Contralateral hemiplegia, hemisensory loss, gaze palsy, spatial neglect, Broca's aphasia (if on left side), it differs from the MCA stem occlusion syndrome in that the leg and foot are partly spared and less involved with weakness than the arm and face ("brachiofacial," or chierobrachial "paralysis"); there is no impairment of alertness
Inferior Division	Contralateral hemianopsia or upper quadrant anopsia, Wernicke's aphasia (if on left side)Constructional dyspraxia (if on right side).

Anterior Cerebral Artery Stroke Syndromes

Table 3.7: Anterior Cerebral Artery Stroke Syndromes

ARTERY OCCLUDED	CLINICAL MANIFESTATIONS
Entire territory	Incontinence Contralateral hemiplegia Abulia Transcortical motor aphasia or motor and sensory aphasia Left limb dyspraxia
Distal:	Contralateral weakness of leg, hip, foot and shoulder, Sensory loss in foot Transcortical motor aphasia or motor and sensory aphasia, Left limb dyspraxia

Disorders of behaviour that may be overlooked in cases of anterior cerebral artery occlusion; they are abulia, or a slowness and lack of spontaneity in all reactions, muteness or a tendency to speak in whispers, and distractibility

Anterior Choroidal Artery Stroke Syndrome

With right-sided lesions, there may be a left spatial neglect and constructional apraxia; slight disorders of speech and language may accompany left-sided lesions.

Analyses of various series of patients shows that the syndrome of the anterior choroidal artery includes the following:

- Hemiparesis affecting the face, arm, and leg
- Prominent hemisensory loss that is often temporary
- Homonymous hemianopia
- When the lateral geniculate body is infarcted, an unusual hemianopia, with sparing of a beak-shaped tongue of vision, within the center of the hemianopic visual field
- Absence of persistent neglect, aphasia, or other higher cortical-function abnormalities

Posterior Cerebral Artery Stroke Syndromes

In approximately 70 percent of individuals, both posterior cerebral arteries are formed by the bifurcation of the basilar artery and thin posterior communicating arteries join this system to the internal carotid arteries. In 20 to 25 percent, one posterior cerebral artery arises from the basilar in the usual way, but the other arises from the internal carotid, a persistent fetal pattern of circulation; fewer than 5 percent have the unusual configuration in which both arise from the corresponding carotid arteries.

Patients with PCA infarcts present with following symptoms:

- Acute vision loss
- Confusion[50]
- New onset posterior cranium headache
- Paresthesias
- Limb weakness
- Dizziness
- Nausea
- Memory loss
- Language dysfunction[51]

The symptom complex of PCA infarct are grouped into two syndromes:

1. P1 syndrome: midbrain, subthalamic, and thalamic signs, which are due to disease of the proximal P1 segment of the PCA or its penetrating branches (thalamogeniculate, Percheron, and posteriorchoroidal arteries):

    a) Claude's syndrome (A third nerve palsy with contralateral ataxia)
    b) Weber's syndrome (A third nerve palsy with contralateral hemiplegia)
    c) Dejerine-Roussy syndrome(contralateral hemisensory loss followed later by an agonizing, burning pain in the affected areas)

2. P2 syndrome: cortical temporal and occipital lobe signs, due to occlusion of the P2 segment distal to the junction of the PCA with the posterior communicating artery.

Cortical blindness is produced when there is bilateral infarction in the distal PCAs (blindness with preserved pupillary light reaction). This results in either the patient being unaware of the blindness or denying the blindness (*Anton'ssyndrome*).

Balint's syndrome, a disorder of the orderly visual scanning of the environment, usually resulting from infarctions secondary to low flow in the "watershed" between the distal PCA and MCA territories, as occurs after cardiac arrest. The lesion usually is in bilateral visual association areas. Patients may experience persistence of a visual image for several minutes despite gazing at another scene (*palinopsia*) or an inabilityto synthesize the whole of an image (*asimultanagnosia*).

VERTEBRAL ARTERY:

The most frequently reported symptom during TIAs caused by ECVA-origin disease is dizziness. Dizziness, often accompanied by swaying towards one side and gait ataxia, visual blurring, perioral paresthesias, and diplopia were the commonest TIA symptoms The most frequent findings in patients with ICVA occlusion are related to ischemia of the lateral medulla which causes the constellation of vertigo, numbness of the ipsilateral face and contralateral limbs, diplopia, hoarseness, dysarthria, dysphagia, and ipsilateral Horner's syndrome (*lateral medullary or Wallenberg's syndrome).*

Rarely, a *medial medullary syndrome* occurs with infarction of the pyramid and contralateral hemiparesis of the arm and leg, sparing the face. If the medial lemniscus and emerging hypoglossal nerve fibers are involved, contralateral loss of joint position sense and ipsilateral tongue weakness occur.

BASILAR ARTERY [52]

TIAs in the proximal basilar distribution may produce vertigo. Other symptoms seen include diplopia, dysarthria, facial or circumoral numbness, and hemisensory symptoms. In general, symptoms of basilar branch TIAs affect one side of the brainstem, whereas symptoms of basilar artery TIAs usually affect both sides, although a "herald" hemiparesis has been emphasized as an initial symptom of basilar occlusion. Most often, TIAs, whether due to impending occlusion of the basilar artery or a basilar branch, are short lived and repetitive, occurring several times a day.

Atherothrombotic occlusion of the basilar artery with infarction usually causes *bilateral* brainstem signs. A gaze paresis or internuclear ophthalmoplegia associated with ipsilateral hemiparesis may be the only manifestation of bilateral brainstem ischemia. Occlusion of a branch of the basilar artery usually causes *unilateral* symptoms and signs involving motor, sensory, and cranial nerves.

Superior cerebellar artery occlusion results in severe ipsilateral cerebellar ataxia, nausea and vomiting, dysarthria, and contralateral loss of pain and temperature sensation over the extremities, body, and face (spino- and trigeminothalamic tract).

Anterior inferior cerebellar artery occlusion produces variable degrees of infarction because the size of this artery and the territory it supplies vary inversely with those of the PICA. The principal symptoms include:

1. Ipsilateral deafness, facial weakness, vertigo, nausea and vomiting, nystagmus, tinnitus, cerebellar ataxia, Horner's syndrome, and paresis of conjugate lateral gaze
2. Contralateral loss of pain and temperature sensation

DIAGNOSIS

Most of the Diagnostic studies done to confirm stroke, detect early potentially life-threatening complications, and direct specific care are available in most EDs 24 hours a day. Random blood glucose can be checked in the ambulance with a finger stick or upon ED arrival and is helpful in ruling out hypoglycemia as a cause for the event or hyperglycemia as a compounding factor. Among the various imaging studies a computed tomography (CT) scan without contrast is recommended to rule out the presence of a hemorrhagic stroke. Further evaluation may include a CT angiogram, magnetic resonance imaging (MRI), and cerebral angiography. MRI allows for better visualization of possible infarcted areas, and angiography is used when intra-arterial (IA) thrombolysis is indicated or when surgical interventions are being considered[53].

- All patients with suspected stroke should have the following studies urgently as part of the acute stroke evaluation[54,55]:
    1. Non-contrast brain CT or brain MRI
    2. Finger stick blood glucose
    3. Oxygen saturation
- Other immediate tests for the evaluation of ischemic and hemorrhagic stroke include the following[54,55]
    1. Electrocardiogram
    2. Complete blood count including platelets
    3. Troponin
    4. Prothrombin time and international normalized ratio (INR)
    5. Activated partial thromboplastin time

6. Ecarin clotting time, thrombin time, or appropriate direct factor Xa activity assay if known or suspected that the patient is taking direct thrombin inhibitor or direct factor Xa inhibitor and is a candidate for thrombolytic therapy with alteplase.

- However, thrombolytic therapy for acute ischemic stroke (see 'Acute therapy' below) should not be delayed while awaiting the results of hematologic studies unless the patient has received anticoagulants or there is suspicion of a bleeding abnormality or thrombocytopenia. The only test that is mandatory before initiation of intravenous alteplase is blood glucose[54]

The following laboratory studies may be appropriate in selected patients[54-56]

1. Serum electrolytes, Blood urea nitrogen
2. Serum creatinine
3. Liver function tests
4. Toxicology screen
5. Blood alcohol level
6. Pregnancy test in women of child-bearing potential
7. Arterial blood gas if hypoxia is suspected
8. Chest radiograph if lung disease is suspected
9. Lumbar puncture if subarachnoid hemorrhage is suspected and head CT scan is negative for blood; note that lumbar puncture will preclude administration of intravenous alteplase (tPA), though tPA should not be given if there is suspicion for subarachnoid hemorrhage as the cause of the symptoms
10. Electroencephalogram if seizures are suspected
11. Cardiac studies: ECG, Echocardiography

Table 3.8-Findings of CT in Ischemic stroke

Findings of CT in Ischemic stroke	
Early hyperacute: 0 to 6 hours	The earliest CT sign visible is a hyperdense segment of a vessel, representing direct visualisation of the intravascular thrombus / embolus and as such is visible immediately
Late hyperacute: 6 to 24 hours	loss of grey-white matter differentiation, and hypoattenuation of deep nuclei cortical hypodensity with associated parenchymal swelling with resultant gyral effacement
Acute: 24 hours to 1 week	With time the hypoattenuation and swelling become more marked resulting in a significant mass effect
Subacute: 1 to 3 weeks	As time goes on the swelling starts to subside and small amounts of cortical petechial haemorrhages (not to be confused with haemorrhagic transformation) result in elevation of the attenuation of the cortex. This is known as the CT fogging phenomenon
Chronic: more 3 weeks	Later still the residual swelling passes, and gliosis sets in eventually appearing as a region of low density with negative mass effect. Cortical mineralisation can also sometimes be seen appearing hyperdense.

Table 3.9:Findings of MRI in Ischemic stroke

Findings of MRI in Ischemic stroke

Imaging Sequence	Early Hyperacute (0–6 hours)	Late Hyperacute (6–24 hours)	Acute (24 hours–1 week)
ADC mapping	Low signal intensity	Low signal intensity	Low signal intensity
Diffusion-weighted	High signal intensity	High signal intensity	High signal intensity
FLAIR	Variable signal intensity; usually high after 6 hours; ipsilateral arterial may be high at 0–2 hours	Usually high signal intensity	High signal intensity
T1-weighted	Isointensity	Usually low signal intensity after 16 hours	Low signal intensity; hyperintensity with cortical necrosis may be seen after 3–5 days
Contrast-enhanced T1-weighted	Arterial enhancement may occur after 0–2 hours; parenchymal cortical enhancement may occur after 2–4 hours in incomplete infarction	Arterial enhancement may occur; parenchymal cortical enhancement may be seen in incomplete infarction*; meningeal enhancement may occur	Arterial and meningeal enhancement may occur†; parenchymal enhancement may occur after 5–7 days in complete infarction
T2-weighted	Isointensity; may see loss of flow void in ipsilateral carotid artery at 0–2 hours in cases of large stroke	Variable; usually high after 8 hours	High signal intensity
Susceptibility-weighted or gradient-echo	May see hemorrhagic transformation within 0–12 hours (unlikely)	May see hemorrhagic transformation within 0–12 hours (unlikely)	Hemorrhagic transformation most likely within 48 hours; risk remains for up to 5 days

TREATMENT

The acute management includes:

1. Ensuring medical stability, with particular attention to airway, breathing, and circulation
2. Quickly reversing any conditions that are contributing to the patient's problem
3. Determining if patients with acute ischemic stroke are candidates for intravenous thrombolytic therapy or endovascular thrombectomy
4. Moving toward uncovering the pathophysiologic basis of the patient's neurologic symptoms

Subacute and long-term assessment and management includes:

1. Physical therapy
2. Prevention of pressure sores, DVT and other complications
3. Testing to determine the precise etiology of the event so as to prevent recurrence.

The history, physical examination, serum glucose, oxygen saturation, and a noncontrast CT scan are sufficient in most cases to guide acute therapy.

Airway, breathing and circulation — Assessing vital signs and ensuring stabilization of airway, breathing, and circulation is part of the initial evaluation of all patients with critical illness, including those with stroke[57]. Patients with decreased consciousness or bulbar dysfunction may be unable to protect their airway, and those with increased intracranial pressure due to hemorrhage, vertebrobasilar ischemia, or bihemispheric ischemia can present with vomiting, decreased respiratory drive, or muscular airway obstruction. Hypoventilation, with a resulting increase in carbon dioxide, may lead to cerebral vasodilation and elevate intracranial pressure. In these cases, intubation may be necessary to restore adequate ventilation and to protect the airway from aspiration. Patients who are hypoxic should receive supplemental oxygen to maintain oxygen saturation >94 percent[57]. Supplemental oxygen should not routinely be given to nonhypoxic patients with acute ischemic stroke.

ACUTE THERAPY —

Reperfusion therapy:

There are two options for reperfusion therapy:

1. Intravenous alteplase and
2. Mechanical thrombectomy.

Full or partial recanalization within 24 hours of stroke onset is associated with a more favourable outcome than persistent occlusion after thrombolysis[58].

Alteplase — also known as recombinant tissue plasminogen activator or tPA is the mainstay of treatment for acute ischemic stroke, provided that treatment is initiated within4.5 hours of clearly defined symptom onset. Benefit of alteplase is time dependent so it is critical to treat patients as quickly as possible. Alteplase initiates local fibrinolysis by binding to fibrin in a thrombus (clot) and converting entrapped plasminogen to plasmin. The plasmin breaks up the thrombus into fibrin degradation products.

Table 3.10: Inclusion/exclusion criteria for intravenous tPA

Inclusion/exclusion criteria for 0-3 hr intravenous tPA for Acute ischemic stroke	**Inclusion/exclusion criteria for 3-4.5 hr intravenous tPA for Acute ischemic stroke**
tPA Eligibility 1. Age ≥18 yr 2. Clinical diagnosis of ischemic stroke causing measurable neurologic deficit and noncontrast head CT showing no hemorrhage. 3. Onset of stroke symptoms well established to be less than 180 min (3 hr) before treatment would begin. **Contraindications** 1. Symptoms minor or rapidly improving. 2. Other stroke or serious head trauma within past 3 mo. 3. Major surgery within last 14 d. 4. Known history of intracranial hemorrhage. 5. Sustained systolic blood pressure >185 mm Hg. 6. Sustained diastolic blood pressure >110 mm Hg. 7. Aggressive treatment necessary to lower blood pressure. 8. Symptoms suggestive of subarachnoid hemorrhage 9. Received heparin within 48 hr and has elevated PTT** 10. Patient has received treatment (not prophylactic) doses of injectable anticoagulants (e.g., enoxaparin) in the past 48 hr.** 11. Patient has taken dabigatran in the last 48 hr (regardless of PTT).** 12. Patient has taken dabigatran in >48 hr AND has an elevated PTT.** 13. Arterial puncture at noncompressible site within 7 d. 14. GI or GU hemorrhage within 21 d. 15. International normalized ratio (INR) >1.7.** 16. Platelet count <100,000/mL. 17. Seizure at onset of stroke (with deficits thought to be related to ictal or post-ictal state and not new stroke). 18. Serum glucose <50 mg/dL. (If glucose is >400 mg/dL, consider other etiology such as unmasking of old deficits vs. new stroke.)	**tPA Eligibility** 1. Age 18–**80 yr**. 2. Clinical diagnosis of ischemic stroke causing measurable neurologic deficit and noncontrast head CT showing no hemorrhage. 3. Onset of stroke symptoms well established to be between **3.0 and 4.5 hr** before treatment would begin. **Contraindications** 1. Symptoms minor or rapidly improving. 2. Seizure at onset of stroke. 3. Major surgery or significant trauma **in past 3 mo.** 4. Blood glucose <50 or **>400 mg/dL**. 5. Prior stroke within the last 3 mo. 6. Known history of or suspected ICH. 7. Systolic blood pressure >185 mm Hg or diastolic blood pressure >110 mm Hg, or aggressive management (**more than a single dose of IV medication**) necessary to reduce BP to these limits. 8. Symptoms suggestive of SAH. 9. Recent (**<10 d**) puncture of a noncompressible blood vessel, external heart massage, or obstetrical delivery. 10. Received heparin within previous 48 hr and an elevated PTT. 11. **Patients receiving Coumadin even with normal PT/INR.** 12. **History of CNS damage** (e.g., neoplasm, aneurysm, intracranial or spinal surgery). 13. Patient has received treatment (not prophylactic) doses of injectable anticoagulants (e.g., enoxaparin) in the past 48 hr. 14. Patient has taken dabigatran in the last 48 hr (regardless of PTT). 15. Patient has taken dabigatran in >48 hr AND has an elevated PTT. 16. Platelet count of below 100,000/mL. 17. Severe stroke assessed clinically (**NIHSS >25**) or by imaging (**>1/3 involvement MCA**). 18. History of prior **disabling** stroke (**MRS 2 or more**) **and diabetes requiring treatment**. 19. Known hemorrhagic diathesis. 20. Recent severe/dangerous bleeding. 21. **Hemorrhagic retinopathy** (e.g., in diabetes, vision disturbance may indicate hemorrhagic retinopathy). 22. **Acute pancreatitis, documented ulcerative GI disease during last 3 mo, esophageal varices, arterial-aneurysm, or AVM.** 23. **Other major disorders associated with a risk of bleeding** such known bacterial endocarditis, pericarditis, or severe liver disease.

Mechanical thrombectomy — Mechanical thrombectomy is indicated for patients with acute ischemic stroke due to a large artery occlusion in the anterior circulation who can be treated within 24 hours of symptom onset or the time last known to be well at stroke centers with appropriate expertise, regardless of whether they receive intravenous alteplase for the same ischemic stroke event. Eligible patients should receive intravenous alteplase without delay even if mechanical thrombectomy is being considered.

TREATMENT BY TIME FROM SYMPTOM ONSET — "Time is brain." The sooner intravenous alteplase treatment is initiated after ischemic stroke, the more likely it is to be beneficial[59]. Eligible patients should be treated within the appropriate 3- or 4.5-hour time limit without any delay.

0 to 3 hours — For eligible patients with acute ischemic stroke and with no contraindications, intravenous alteplase therapy should be initiated within 3 hours of clearly defined symptom onset. Patients in this time window should also be evaluated to determine if they are candidates for mechanical thrombectomy.

3 to 4.5 hours — For otherwise eligible patients who could not be treated within 3 hours, intravenous alteplase therapy is suggested provided that inclusion/exclusion criteria for 3- 4.5 hr are met. Patients in this time window should also be evaluated to determine if they are candidates for mechanical thrombectomy.

4.5 to 6 hours —Intravenous alteplase is not advised because harm may exceed benefit, but they should be evaluated to determine if they are candidates for mechanical thrombectomy.

6 to 24 hours — Patients beyond 6 hours from ischemic stroke symptom onset are not eligible for treatment with intravenous alteplase. However, mechanical thrombectomy can be considered at specialized stroke centers using imaging-based selection of patients[60].

>24 hours — Patients after 24 hours of onset of ischemic stroke symptom are not eligible for treatment with intravenous alteplase or mechanical thrombectomy.

Unwitnessed stroke onset and "wake-up" stroke — Here the exact time of stroke onset is not known. Such patients are not eligible for alteplase treatment unless the time last known to be normal is less than 4.5 hours. Imaging-based selection of patients with unknown stroke onset time for intravenous alteplase treatment is under investigation.

Antithrombotic treatment:

Antiplatelets: Aspirin is the only antiplatelet agent that has been proven effective for the acute treatment of ischemic stroke. It's given at an initial dose of 325mg within 24-48 hrs followed by 81mg/day. Among patients with TIA or minor stroke who can be treated within 24 hours after the onset of symptoms, dual antiplatelet i.e. combination of clopidogrel and aspirin is superior to aspirin alone for reducing the risk of stroke in the first 90 days without increasing the risk of hemorrhage[61].

Anticoagulation: Numerous clinical trials have failed to demonstrate any benefit of anticoagulation in the primary treatment of atherothrombotic cerebral ischemia.

Lipid lowering with high intensity statin therapy: LDL target should be < 100mg/dl with some evidence from the SPARC trial to suggest an aggressive target of < 70mg/dl.

STROKE MANAGEMENT ISSUES — In addition to stabilization of airway, breathing, and circulation, and rapid neurologic evaluation discussed above, early key management issues that often arise in acute stroke include control of blood pressure, fluid management, treatment of abnormal bloodglucose levels, swallowing assessment, and treatment of fever and infection.

Blood pressure control in the acute phase of ischemic stroke:

The hypertensive effect is transient, as blood pressure falls by as much as 20/10 mmHg within 10 days. Lowering the systemic blood pressure in patients with acute ischemic stroke has been associated with clinical deterioration in observational studies; several different groups have found an adverse effect of reducing blood pressure in the first 24hours after stroke onset.

Indications for use of anti-hypertensives include:

1. Before thrombolytic therapy is started (target is ≤185/110mmhg)
2. Active ischemic coronary disease,
3. Heart failure,
4. Aortic dissection,
5. Hypertensive encephalopathy, or
6. Pre-eclampsia/eclampsia[54,62].

Otherwise patients with ischemic stroke should not be treated with anti-hypertensives unless the hypertension is extreme (systolic blood pressure >220 mmHg or diastolic blood pressure >120 mmHg. When treatment is indicated, cautious lowering of blood pressure by approximately 15 percent during the first 24 hours after stroke onset is suggested.

Choice of antihypertensive agent -- Intravenous labetalol, nicardipine, nitroprusside and clevidipine[63]

Fluids —For most patients with acute stroke and volume depletion, isotonic saline without dextrose is the agent of choice for intravascular fluid repletion and maintenance fluid therapy[64] as intravascular volume depletion is frequent in the setting of acute stroke, particularly in older adult patients[65]. In general, it is best to

avoid excess free water (Eg, as in ½ isotonic saline) because hypotonic fluids may exacerbate cerebral edema in acute stroke and are less useful than isotonic solutions for replacing intravascular volume. In addition, it is best to avoid fluids containing glucose, which may exacerbate hyperglycemia.

Hypoglycemia —It is important to check the blood sugar and rapidly correct low serum glucose (<60 mg/dL [3.3 mmol/L]) at the first opportunity [54] as hypoglycemia can cause focal neurologic deficits mimicking stroke.

Hyperglycemia — Hyperglycemia, is associated with poor functional outcome[66-71]. Stress hyperglycemia may be the most common cause[68],although newly diagnosed diabetes is also important[69].Hyperglycemia may augment brain injury by several mechanisms including increased tissue acidosis from anaerobic metabolism, free radical generation, and increased blood brain barrier permeability. In light of these observations, it is reasonable to treat severe hyperglycemia in the setting of acute stroke.

The American Heart Association/American Stroke Association guidelines foracute ischemic stroke recommend treatment for hyperglycemia to achieve serum glucose concentrations in the range of 140 to 180 mg/dL (7.8 to 10 mmol/L). The European Stroke Initiative guidelines recommend treatment for glucose >180 mg/dL (>10 mmol/L)[72].

Swallowing assessment — Dysphagia is usually seen after stroke. It's also a major risk factor for developing aspiration pneumonia. It is important to assess swallowing function prior to administering oral medications or food. Thus, prevention of aspiration in patients with acute stroke includes initial NPO status until swallowing function is evaluated.

Head and body position — During the acute phase of stroke, the position of the patient and the head of bed should be individualized with respect to the risk of elevated intracranial pressure and aspiration, and the presence of comorbid cardiopulmonary disease[73,74].It is advised to keep the head in neutral alignment with the body and elevating the head ofthe bed to 30 degrees for patients in the acute phase of stroke who are at risk for any of the following problems:

1. Elevated intracranial pressure (i.e., intracerebral hemorrhage, cerebral edema >24 hours from stroke onset in patients with large ischemic infarction)
2. Aspiration (e.g., those with dysphagia and/or diminished consciousness)
3. Cardiopulmonary decompensation or oxygen desaturation (e.g., those with chronic cardiac and pulmonary disease)

In the absence of these problems, the head of bed is kept in a position that is most comfortable for the patient.

Mobilization of stable patients after 24 hours may lessen the likelihood of major complications such as pneumonia, deep vein thrombosis, pulmonary embolism, and pressure sores after stroke. Exceptions may include those who exhibit neurologic deterioration upon assuming more upright postures. In addition, there is a potential increased risk of aspiration if a flat position is maintained for a prolonged period[75].

However, very early mobilization, within 24 hours of symptom onset, may be harmful. The multicenter randomized AVERT trial, with over 2000 patients, evaluated a protocol of very early mobilization, which was started within 24 hours of stroke onset and consisted of frequent out-of-bed activity including sitting, standing, and walking. Compared with usual care, very early mobilization and early rehabilitative therapies reduced the odds of a favourable outcome at three months [76].

Fever — Fever may contribute to brain injury in patients with an acute stroke. This concept has been demonstrated in animal models in which ischemic injury is increased in the presence of elevated temperature. Hyperthermia may act via several mechanisms to worsen cerebralischemia[77]:

1. Enhanced release of neurotransmitters
2. Exaggerated oxygen radical production
3. More extensive blood-brain barrier breakdown
4. Increased numbers of potentially damaging ischemic depolarizations in the focal ischemic penumbra
5. Impaired recovery of energy metabolism and enhanced inhibition of protein kinases
6. Worsening of cytoskeletal proteolysis

Fever is associated with unfavourable outcomes in human studies of stroke[78,79]. Fever was significantly associated with increased mortality rates, greater disability, more dependence, worse functional outcome, greater severity, and longer intensive care unit and hospital stays.

The source of fever should be investigated and treated, and antipyretics should be used to lower temperature in febrile patients with acute stroke. It's advisable to maintain normothermia for at least the first several days after an acute stroke[77].

Stroke unit care — Evidence suggests that patients with acute stroke have better outcomes when admitted to a hospital unit that is specialized for the care of patients with all types of acute stroke, including ischemic, intracerebral hemorrhage, and subarachnoid hemorrhage[80]. The precise components of an acute stroke unit vary

between centers and countries, but generally include a hospital ward with dedicated telemetry beds that is continuously staffed by a team of physicians, nurses and other personnel who specialize in stroke care, emphasizing expertise in vascular neurology and neurosurgery[81,82].Additional components include prompt availability of neuroimaging (e.g., CT, MRI, various types of angiography, ultrasound, transcranial Doppler) and cardiac imaging. Implementation of stroke protocols and disease-performance measures may contribute to improved outcomes and decreased risk of stroke-related complications, as shown in some reports. Current national guidelines support stroke unit care, when available, for patients with suspected acute stroke[54].

INVESTIGATIONAL THERAPIES —

Investigational methods of reperfusion therapy for acute ischemic stroke include alternative fibrinolytic agents such as tenecteplase[83], intra-arterial infusion of thrombolytic agents such as alteplase, ultrasound-enhanced thrombolysis [84], combined intravenous and intra-arterial thrombolysis, and GP IIb/IIIa antagonists such as tirofiban [85]. However, these interventions remain unproven. For patients with acute ischemic stroke, the following treatments should not be used outside the setting of clinical trials:

1. Intravenous desmoteplase, urokinase, or any thrombolytic agents other than intravenous alteplase (tPA).
2. Intravenous glycoprotein IIb/IIIa receptor inhibitors
3. Combinations of interventions (other than intravenous alteplase and mechanical thrombectomy) to restore perfusion

COMPLICATIONS —

The prevention of medical complications of stroke is an important goal of stroke management, and this aspect of care begins with initial evaluation of the patient. Common acute and subacute medical problems associated with stroke include:

1. Myocardial infarction[86]
2. Heart failure
3. Dysphagia[87]
4. Aspiration pneumonia
5. Urinary tract infection
6. Deep vein thrombosis[88]
7. Pulmonary embolism
8. Dehydration
9. Malnutrition
10. Pressure sores
11. Orthopedic complications and contractures

NIHSS

National Institutes of Health Stroke Scale (NIHSS) is a tool used by healthcare providers to objectively quantify the impairment caused by a stroke. The NIHSS is composed of 11 items. The individual scores from each item are summed in order to calculate a patient's total NIHSS score. The maximum possible score is 42, with the minimum score being a 0[89].

Table 3.11: NIHSS

INSTRUCTIONS	SCALE DEFINITION	SCORE
1a. Level of Consciousness: The investigator must choose a response if a full evaluation is prevented by such obstacles as an endotracheal tube, language barrier, orotracheal trauma/ bandages. A 3 is scored only if the patient makes no movement (other than reflexive posturing) in response to noxious stimulation.	0 = **Alert;** keenly responsive.	
	1 = **Not alert**; but arousable by minor stimulation to obey, answer, or respond.	
	2 = **Not alert**; requires repeated stimulation to attend or is obtunded and requires strong or painful stimulation to make movements (not stereotyped).	
	3 = Responds only with reflex motor or autonomic effects or totally unresponsive, flaccid, and areflexic.	
1b. LOC Questions: The patient is asked the month and his/her age. The answer must be correct - there is no partial credit for being close. Aphasic and stuporous patients who do not comprehend the questions will score 2. Patients unable to speak because of endotracheal intubation, orotracheal trauma, severe dysarthria from any cause, language barrier, or any other problem not secondary to aphasia are given a 1. It is important that only the initial answer be graded and that the examiner not "help" the patient with verbal or non-verbal cues.	0 = **Answers** both questions correctly.	
	1 = **Answers** one question correctly.	
	2 = **Answers** neither question correctly.	
1c. LOC Commands: The patient is asked to open and close the eyes and then to grip and release the non-paretic hand. Substitute another one step command if the hands cannot be used. Credit is given if an unequivocal attempt is made but not completed due to weakness. If the patient does not respond to command, the task should be demonstrated to him or her (pantomime), and the result scored (i.e., follows none, one or two commands). Patients with trauma, amputation, or other physical impediments should be given suitable one-step commands. Only the first attempt is scored.	0 = **Performs** both tasks correctly	
	1 = **Performs** one task correctly	
	2 = **Performs** neither task correctly.	

2. Best Gaze: Only horizontal eye movements will be tested. Voluntary or reflexive (oculocephalic) eye movements will be scored, but caloric testing is not done. If the patient has a conjugate deviation of the eyes that can be overcome by voluntary or reflexive activity, the score will be 1. If a patient has an isolated peripheral nerve paresis (CN III, IV or VI), score a 1. Gaze is testable in all aphasic patients. Patients with ocular trauma, bandages, pre-existing blindness, or other disorder of visual acuity or fields should be tested with reflexive movements, and a choice made by the investigator. Establishing eye contact and then moving about the patient from side to side will occasionally clarify the presence of a partial gaze palsy	0 = **Normal.**	
	1 = **Partial gaze palsy;** gaze is abnormal in one or both eyes but forced deviation or total gaze paresis is not present.	
	2 = **Forced deviation,** or total gaze paresis not overcome by the oculocephalic manoeuvre	
3. Visual: Visual fields (upper and lower quadrants) are tested by confrontation, using finger counting or visual threat, as appropriate. Patients may be encouraged, but if they look at the side of the moving fingers appropriately, this can be scored as normal. If there is unilateral blindness or enucleation, visual fields in the remaining eye are scored. Score 1 only if a clear-cut asymmetry, including quadrantanopia, is found. If patient is blind from any cause, score 3. Double simultaneous stimulation is performed at this point. If there is extinction, patient receives a 1, and the results are used to respond to item 11.	0 = **No visual loss**	
	1 = **Partial hemianopia.**	
	2 = **Complete hemianopia**	
	3=**Bilateral hemianopia** (blind including cortical blindness).	
4. Facial Palsy: Ask – or use pantomime to encourage – the patient to show teeth or raise eyebrows and close eyes. Score symmetry of grimace in response to noxious stimuli in the poorly responsive or non-comprehending patient. If facial trauma/bandages, orotracheal tube tape or other physical barriers obscure the face, these should be removed to the extent possible.	0 = **Normal** symmetrical movements.	
	1 = **Minor paralysis** (flattened nasolabial fold, asymmetry on smiling)	
	2 = **Partial paralysis** (total or near-total paralysis of lower face).	
	3 = **Complete paralysis** of one or both sides (absence of facial movement in the upper and lower face).	

5. Motor Arm: The limb is placed in the appropriate position: extend the arms (palms down) 90 degrees (if sitting) or 45 degrees (if supine). Drift is scored if the arm falls before 10 seconds. The aphasic patient is encouraged using urgency in the voice and pantomime, but not noxious stimulation. Each limb is tested in turn, beginning with the non-paretic arm. Only in the case of amputation or joint fusion at the shoulder, the examiner should record the score as untestable (UN), and clearly write the explanation for this choice.	0 = **No drift;** limb holds 90 (or 45) degrees for full 10 seconds.	
	1 = **Drift;** limb holds 90 (or 45) degrees, but drifts down before full 10 seconds; does not hit bed or other support	
	2 = **Some effort against gravity;** limb cannot get to or maintain (if cued) 90 (or 45) degrees, drifts down to bed, but has some effort against gravity.	
	3 = **No effort against gravity;** limb falls	
	4 = **No movement.**	
	UN = **Amputation** or joint fusion, explain:	
	5a. Left Arm	
	5b. Right Arm	
6. Motor Leg: The limb is placed in the appropriate position: hold the leg at 30 degrees (always tested supine). Drift is scored if the leg falls before 5 seconds. The aphasic patient is encouraged using urgency in the voice and pantomime, but not noxious stimulation. Each limb is tested in turn, beginning with the non-paretic leg. Only in the case of amputation or joint fusion at the hip, the examiner should record the score as untestable (UN), and clearly write the explanation for this choice.	0 = **No drift;** leg holds 30-degree position for full 5 seconds.	
	1 = **Drift;** leg falls by the end of the 5-second period but does not hit bed.	
	2 = **Some effort against gravity;** leg falls to bed by 5 seconds but has some effort against gravity.	
	3 = **No effort against gravity;** leg falls to bed immediately	
	4 = **No movement**	
	UN = **Amputation** or joint fusion, explain:	
	6a. Left Leg	
	6b. Right Leg	
7. Limb Ataxia: This item is aimed at finding evidence of a unilateral cerebellar lesion. Test with eyes open. In case of visual defect, ensure testing is done in intact visual field. The finger-nose-finger and heel-shin tests are performed on both sides, and ataxia is scored only if present out of proportion to weakness. Ataxia is absent in the patient who cannot understand or is paralyzed. Only in	0 = **Absent.**	
	1 = **Present in one limb.**	
	2 = **Present in two limbs.**	
	UN = **Amputation** or joint fusion, explain	

the case of amputation or joint fusion, the examiner should record the score as untestable (UN), and clearly write the explanation for this choice. In case of blindness, test by having the patient touch nose from extended arm position.		
8. Sensory: Sensation or grimace to pinprick when tested, or withdrawal from noxious stimulus in the obtunded or aphasic patient. Only sensory loss attributed to stroke is scored as abnormal and the examiner should test as many body areas (arms [not hands], legs, trunk, face) as needed to accurately check for hemisensory loss. A score of 2, "severe or total sensory loss," should only be given when a severe or total loss of sensation can be clearly demonstrated. Stuporous and aphasic patients will, therefore, probably score 1 or 0. The patient with brainstem stroke who has bilateral loss of sensation is scored 2. If the patient does not respond and is quadriplegic, score 2. Patients in a coma (item 1a=3) are automatically given a 2 on this item.	0 = **Normal;** no sensory loss	
	1 = **Mild-to-moderate sensory loss;** patient feels pinprick is less sharp or is dull on the affected side; or there is a loss of superficial pain with pinprick, but patient is aware of being touched.	
	2 = **Severe to total sensory loss;** patient is not aware of being touched in the face, arm, and leg.	
9. Best Language: A great deal of information about comprehension will be obtained during the preceding sections of the examination. For this scale item, the patient is asked to describe what is happening in the attached picture, to name the items on the attached naming sheet and to read from the attached list of sentences. Comprehension is judged from responses here, as well as to all of the commands in the preceding general neurological exam. If visual loss interferes with the tests, ask the patient to identify objects placed in the hand, repeat, and produce speech. The intubated patient should be asked to write. The patient in a coma (item 1a=3) will automatically score 3 on this item. The examiner must choose a score for the patient with stupor or limited cooperation, but a score of 3 should be used only if the patient is mute and follows no one-step commands.	0 = **No aphasia;** normal.	
	1 = **Mild-to-moderate aphasia;** some obvious loss of fluency or facility of comprehension, without significant limitation on ideas expressed or form of expression. Reduction of speech and/or comprehension, however, makes conversation about provided materials difficult or impossible. For example, in conversation about provided materials, examiner can identify picture or naming card content from patient's response	
	2 = **Severe aphasia;** all communication is through fragmentary expression; great need for inference, questioning, and guessing by the listener. Range of information that can be exchanged is limited; listener	

	carries burden of communication. Examiner cannot identify materials provided from patient response	
	3 = **Mute, global aphasia;** no usable speech or auditory comprehension.	
10. Dysarthria: If patient is thought to be normal, an adequate sample of speech must be obtained by asking patient to read or repeat words from the attached list. If the patient has severe aphasia, the clarity of articulation of spontaneous speech can be rated. Only if the patient is intubated or has other physical barriers to producing speech, the examiner should record the score as untestable (UN), and clearly write an explanation for this choice. Do not tell the patient why he or she is being tested.	0 = **Normal.**	
	1 = **Mild-to-moderate dysarthria;** patient slurs at least some words and, at worst, can be understood with some difficulty.	
	2 = **Severe dysarthria;** patient's speech is so slurred as to be unintelligible in the absence of or out of proportion to any dysphasia oris mute/anarthric.	
	UN = **Intubated** or other physical barrier, explain:	
11. Extinction and Inattention (formerly Neglect): Sufficient information to identify neglect may be obtained during the prior testing. If the patient has a severe visual loss preventing visual double simultaneous stimulation, and the cutaneous stimuli are normal, the score is normal. If the patient has aphasia but does appear to attend to both sides, the score is normal. The presence of visual spatial neglect or anosagnosia may also be taken as evidence of abnormality. Since the abnormality is scored only if present, the item is never untestable.	0 = **No abnormality.**	
	1 = **Visual, tactile, auditory, spatial, or personal inattention** or extinction to bilateral simultaneous stimulation in one of the sensory modalities.	
	2 = **Profound hemi-inattention or extinction to more than one modality;** does not recognize own hand or orients to only one side of space	

mRS[90]

The Modified Rankin Scale (mRS) is used to measure the degree of disability in patients who have had a stroke, as follows

Table 3.12: mRS

0	No symptoms at all
1	No significant disability despite symptoms; able to carry out all usual duties and activities
2	Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance
3	Moderate disability; requiring some help, but able to walk without assistance
4	Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
5	Severe disability; bedridden, incontinent and requiring constant nursing care and attention
6	Dead

RED CELL DISTRIBUTION WIDTH:

RDW is a parameter of red blood cell which measures the variance in red cell size and volume. RDW can be measured in routine completed haemogram. High RDW in complete blood count means there is an increased variation in size of red blood cells in peripheral blood smear.

It can be reported as co-efficient of variance (CV) or Standard Deviation (SD):

1. RDW-CV (%)
2. RDW-SD (fl)

The RDW-CV % is calculated from SD and MCV. The formula is:

RDW-CV (%) = 1 SD of RBC volume/MCV * 100

RDW-SD (fl): This is measurement of width of RBC in distribution histogram. It is measured by calculating the width in femtolitre, at a point that is 20% above the baseline.

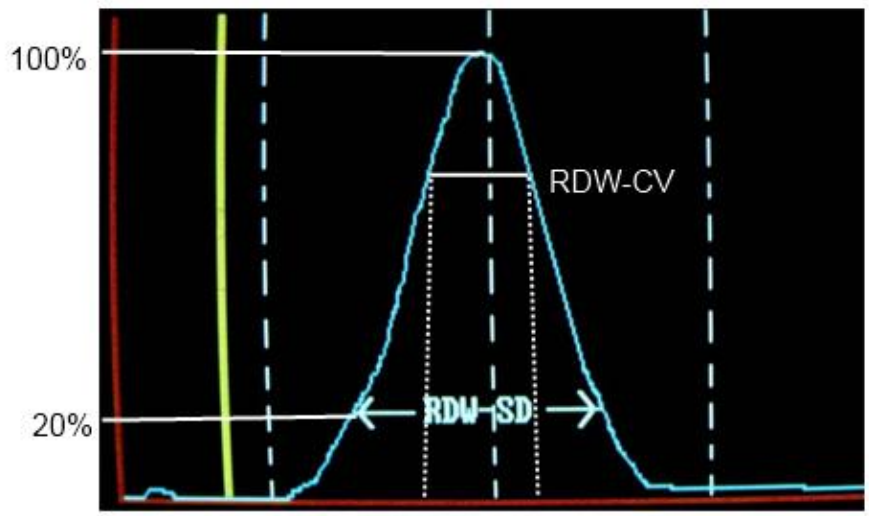


Fig 3.7: RBC Histogram

CONDITIONS WITH ELEVATED RDW LOW MCV

1. Iron deficiency anemia
2. Thalassemia

CONDITIONS WITH ELEVATED RDW WITH LOW OR INCREASED MCV

1. B12 deficiency
2. Folate deficiency
3. Recent transfusion

CONDITIONS WITH ELEVATED RDW/ ELEVATED MCV

1. Liver disease
2. Hemolytic anemia

Recent studies have demonstrated that increased RDW is an independent predictor of overall as well as cardiovascular mortality. A study done by Kara et al showed that RDW may be used as a prognostic marker in stroke patients[12]. However, the mechanism underlying this relationship between RDW and cardiovascular disease (CVD) remains unclear.

Proposed mechanism:

Inflammation is important in the development of ischemic stroke, atherosclerosis and ischemia. As a marker of inflammation, RDW is correlated with other inflammatory markers such as CRP and tumor necrosis factor receptor[91].

Chronic inflammation, oxidative stress and neuro-humoral activation may contribute to the development of atherosclerosis, and elevated RDW may be useful as a simple parameter to follow the development of atherosclerosis.

Oxidative stress is the imbalance between in-vivo oxidation and antoxidation[92]. This imbalance will cause oxidative damage to nucleic acids, proteins and lipids, thus affecting the survival of red blood cells, which in turn results in elevated RDW[93]. Recent studies have shown that antioxidants can improve the body's antioxidant capacity, reduce blood lipids and oxidative damage from ischemic stroke[94].

In other words, RDW values were related to the levels of oxidation and antioxidants, which were related to the severity of ischemic stroke.

The present study was taken up to study RDW in acute ischemic stroke patients and its correlation with severity and functional outcome.

METHODOLOGY

SOURCE OF DATA:

The study was conducted among patients presenting with acute ischemic stroke to Department of General Medicine at KLES Dr Prabhakar Kore Hospital & MRC, Belgaum fulfilling the below mentioned inclusion and exclusion criteria.

STUDY DESIGN

It was a Cross sectional study conducted over a period of one year between January 2017 to December 2017

INCLUSION CRITERIA:

Patients diagnosed with acute ischemic stroke as evidenced by MRI/CT Brain.

EXCLUSION CRITERIA:

1. Patients younger than 18 years of age
2. CT diagnosis of cerebral hemorrhage, subdural hematoma, intracerebral mass, or cerebrovascular damage secondary to trauma;
3. Presence of infection, known immunological disorders, malignancy, or pregnancy;
4. Presence of hemoglobinopathy or other conditions that may be associated with abnormal RDW such as sickle cell anemia, thalassemia, or other anemias or current use of iron, folic acid, or vitamin B_{12} supplements.

METHODOLOGY:

Patients who were diagnosed with acute ischemic stroke based on CT/MRI brain were included in this study. They were scored based on NIHSS and underwent blood investigations including RDW. At the time of discharge mRS was calculated for these patients. Statistical analysis was done to determine correlation of RDW with NIHSS and mRS in patients with acute ischemic stroke.

SAMPLE SIZE CALCULATION-

According to formula: $n=4*pq/ d^2$

Where n= sample number

p=prevalence

q= 100-p

d= 10 % of p

Hence n= 4*80*20/8*8 = 100

SAMPLING METHOD

Random sampling

STATISTICAL ANALYSIS-

Age and gender distribution of the sample was described using mean +/- standard deviation and frequency respectively. Prevalence of high RDW was described as frequency. Pearson's correlation coefficient was used to determine correlation between RDW and NIHSS, RDW and mRS.

RESULTS

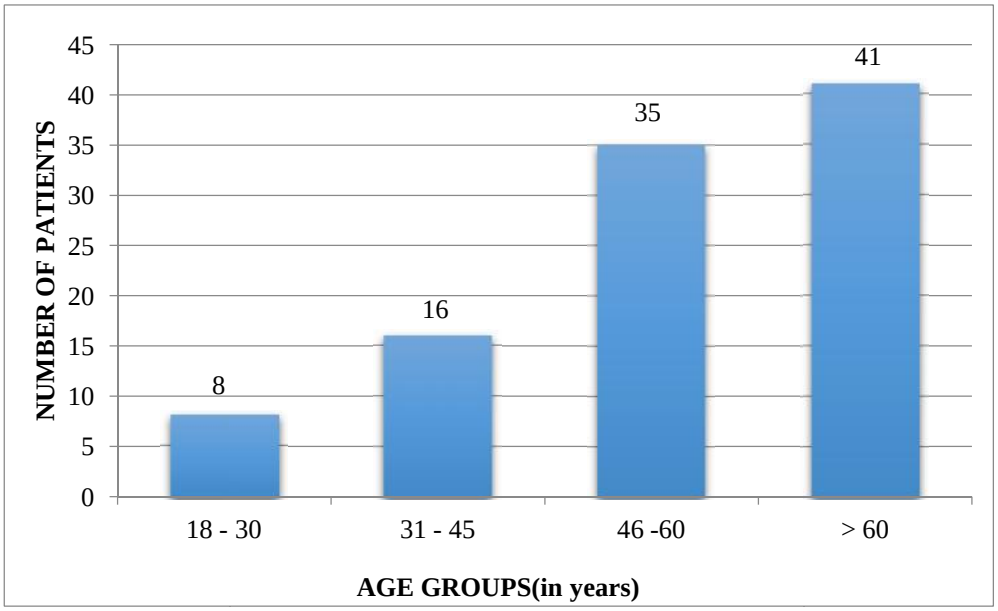
The present study was conducted on 100 patients diagnosed with acute ischemic stroke in KLES Dr Prabhakar Kore hospital and MRC Belagavi from Jan 2017 to Dec 2017.

The data obtained was tabulated as below.

TABLE 5.1- AGE DISTRIBUTION

AGE IN YEARS	NUMBER	PERCENTAGE
18 - 30	8	8
31 - 45	16	16
46 - 60	35	35
>60	41	41
TOTAL	100	100
MEAN ± SD= 56.88 ± 15.82		

GRAPH 5.1: AGE DISTRIBUTION

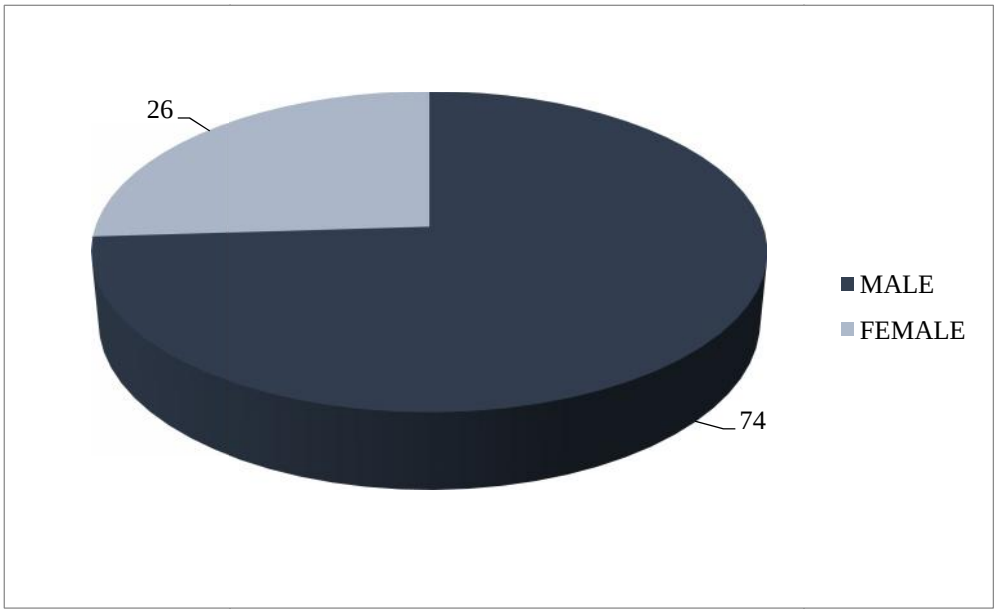


The study population consisted of patients from different age groups ranging from 18 years to 90 years with mean age being 56.88 ±15.82 years. In the present study maximum number of patients were in the age group greater than 60 years (41 patients). We also found that 24 patients came under stroke in young (<45 years) age group.

TABLE 5.2- GENDER DISTRIBUTION

GENDER	NUMBER	PERCENTAGE
MALE	74	74
FEMALE	26	26
TOTAL	100	100

GRAPH 5.2: GENDER DISTRIBUTON

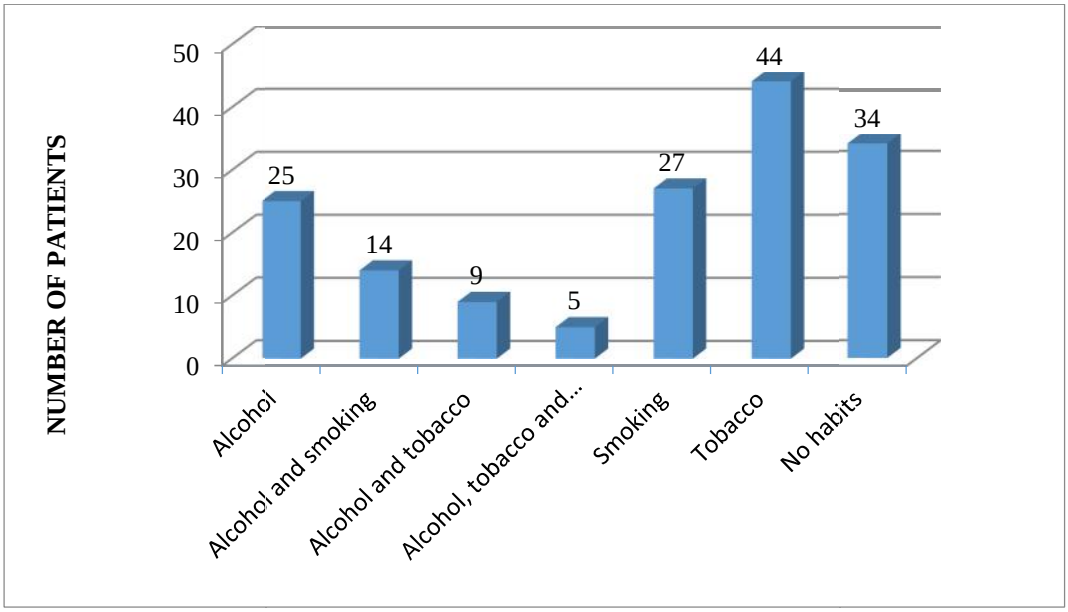


In the present study out of 100 cases 74 (74%) were males and 26 (26%) were females. Male preponderance was seen with male to female ratio of 2.85 : 1.

TABLE 5.3: HABITS

HABITS	DISTRIBUTION	
	NUMBER	PERCENTAGE
ALCOHOL	25	25
ALCOHOL AND SMOKING	14	14
ALCOHOL AND TOBACCO	9	9
ALCOHOL, TOBACCO AND SMOKING	5	5
SMOKING	27	27
TOBACCO	44	44
NO HABITS	34	34

GRAPH 5.3: HABITS

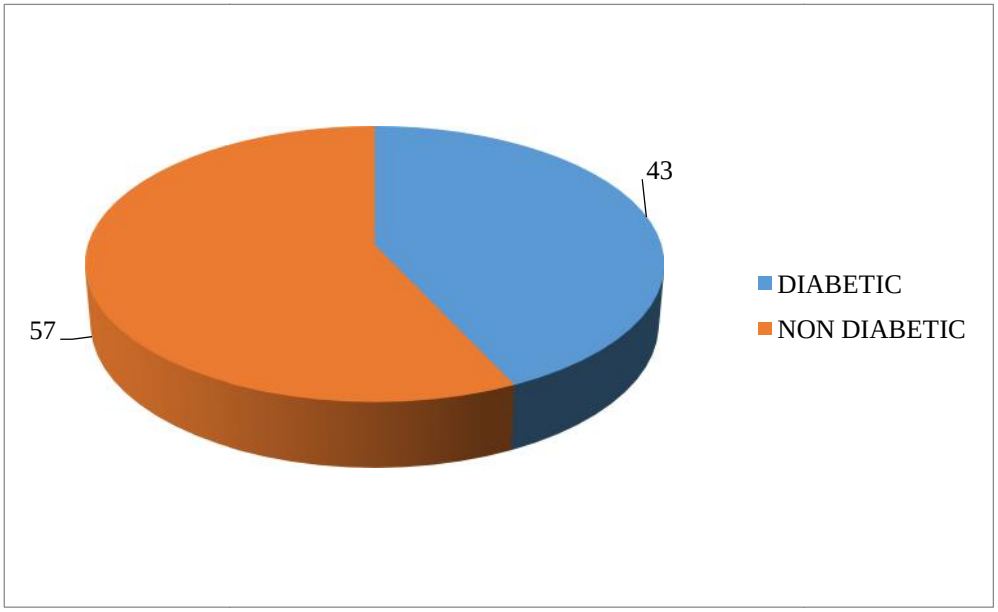


In the present study tobacco chewing (44%) was the single most common habit found among patients with stroke followed by smoking (27%) and alcohol (25%). However 34% of the patients did not have any habits.

TABLE 5.4- DIABETES MELLITUS AS A RISK FACTOR IN ACUTE ISCHEMIC STROKE

	NUMBER	PERCENTAGE
DIABETIC	43	43
NON DIABETIC	57	57
TOTAL	100	100

GRAPH 5.4: DIABETES IN ISCHEMIC STROKE

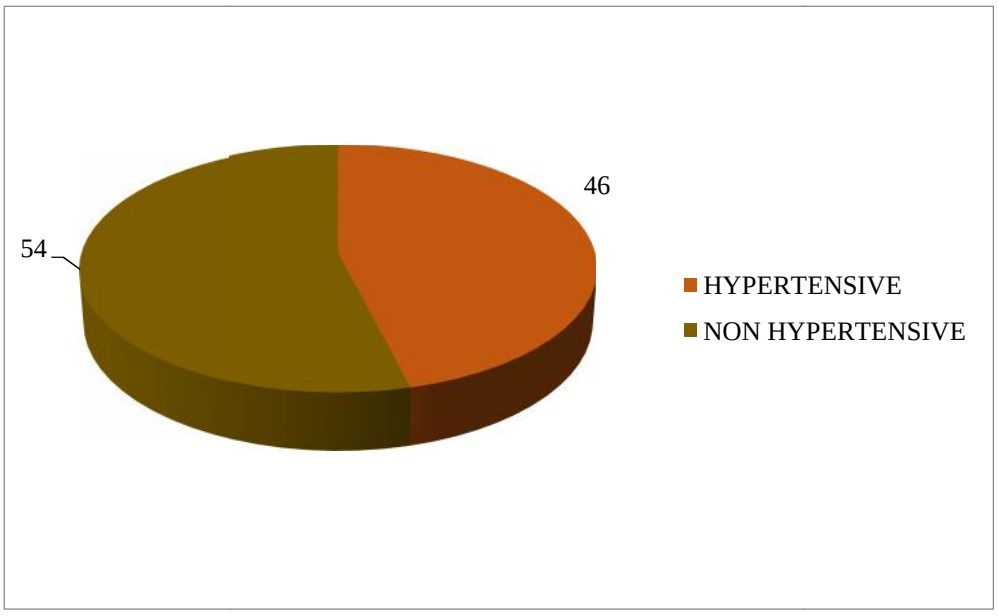


In our study we found that 43% of the ischemic stroke patients had diabetes.

TABLE 5.5- HYPERTENSION AS A RISK FACTOR IN ACUTE ISCHEMIC STROKE

	NUMBER	PERCENTAGE
HYPERTENSIVE	46	46
NON HYPERTENSIVE	54	54
TOTAL	100	100

GRAPH 5.5: HYPERTENSION IN ISCHEMIC STROKE

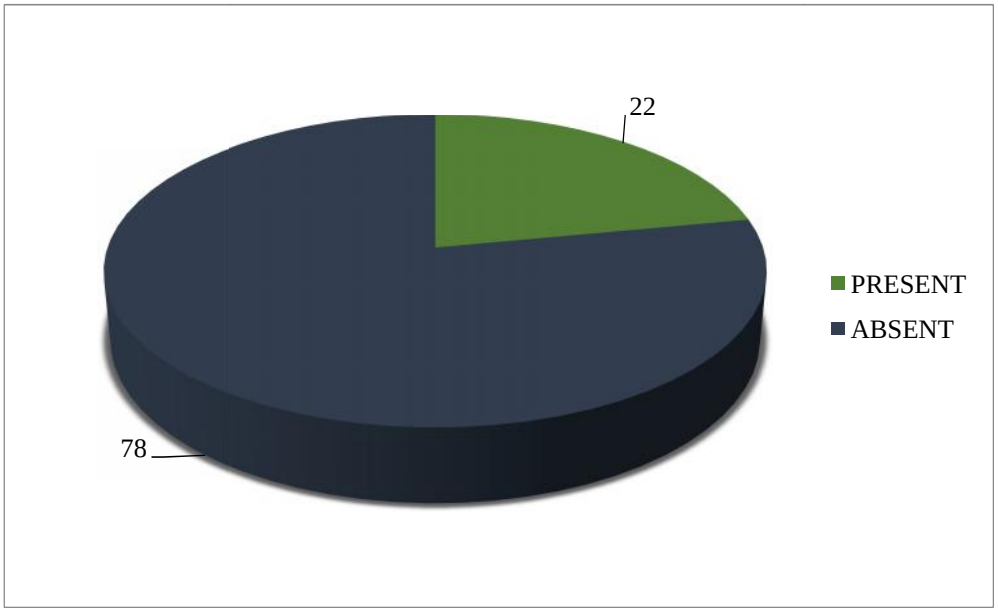


In our study we found that 46% of the ischemic stroke patients had hypertension.

TABLE 5.6- TRANSIENT ISCHEMIC ATTACK AS A RISK FACTOR IN ACUTE ISCHEMIC STROKE

	NUMBER	PERCENTAGE
HISTORY OF TIA	22	22
NO HISTORY OF TIA	78	78
TOTAL	100	100

GRAPH 5.6 : HISTORY OF TIA

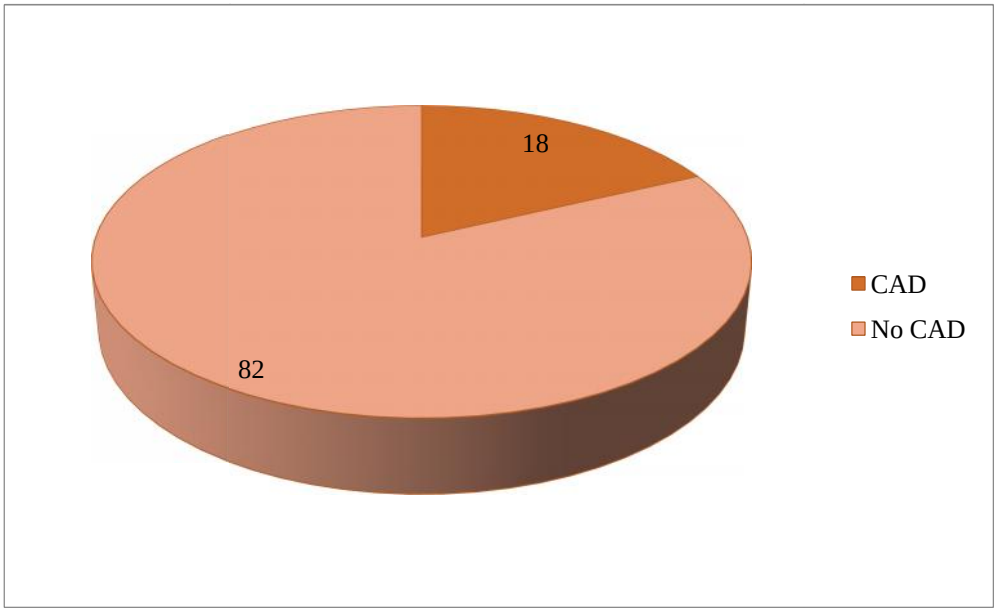


Our study showed that out of the 100 study population 22 had a history of TIA.

TABLE 5.7- CORONARY ARTERY DISEASE AS A RISK FACTOR IN ACUTE ISCHEMIC STROKE

	NUMBER	PERCENTAGE
CAD	18	18
NO CAD	82	82
TOTAL	100	100

GRAPH5.7: CAD IN ISCHEMIC STROKE

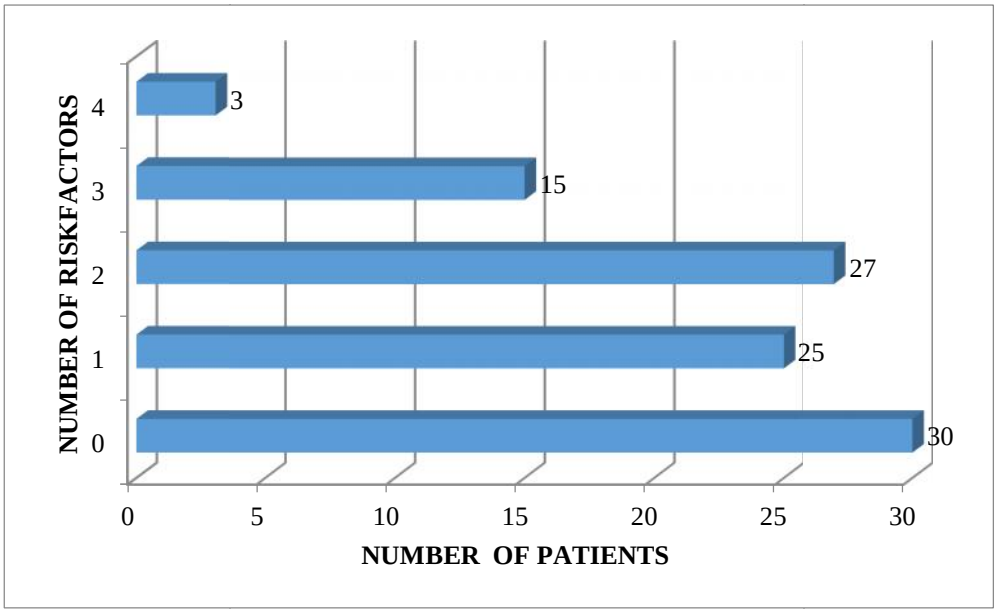


In our study 18% of the study population had history of coronary artery disease.

TABLE 5.8 DISTRIBUTION OF RISK FACTORS AMONG STUDY POPULATION

Number of risk factors	Number of patients
0	30
1	25
2	27
3	15
4	3
Total	100

GRAPH 5.8 : NUMBER OF RISK FACTORS



In our study 30% percent of the patients had no known co-morbidities. Whereas 15% of them had 3 co-morbidities.

TABLE 5.9- LABORATORY VALUES

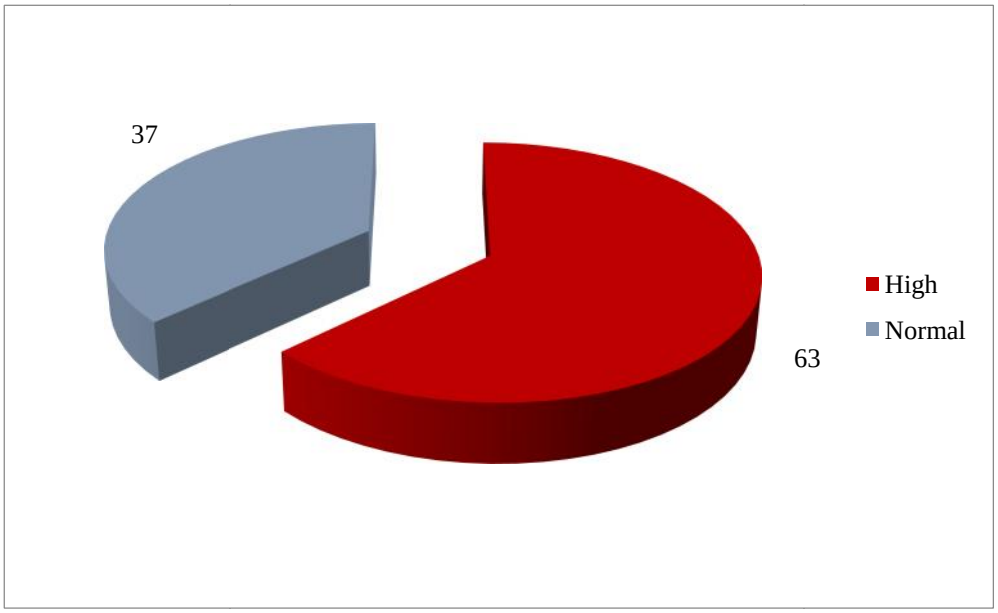
	MEAN	S.D.	RANGE
RDW(%)	14.68	1.36	13.0 TO18.7
HEMOGLOBIN(mg/dl)	13.88	1.41	11.3 TO 17.1
RBC COUNT (million cells/cumm)	4.65	0.65	2.49 TO 6.02
TOTAL COUNT (cells/cumm)	10851.28	4404.22	8.8 TO 25100
PLATELETS (lakh cells /cumm)	2.77	0.92	1.11 TO 5.41

The above table shows the descriptive statistics (mean, standard deviation, range) with respect to the laboratory values like RDW, hemoglobin, RBC count, total leucocyte count and platelets.

TABLE 5.10: RDW IN ACUTE ISCHEMIC STROKE

RDW	NUMBER	PERCENTAGE
HIGH	63	63
NORMAL	37	37
TOTAL	100	100

GRAPH 5.9: STUDY OF RDW IN ACUTE ISCHEMIC STROKE

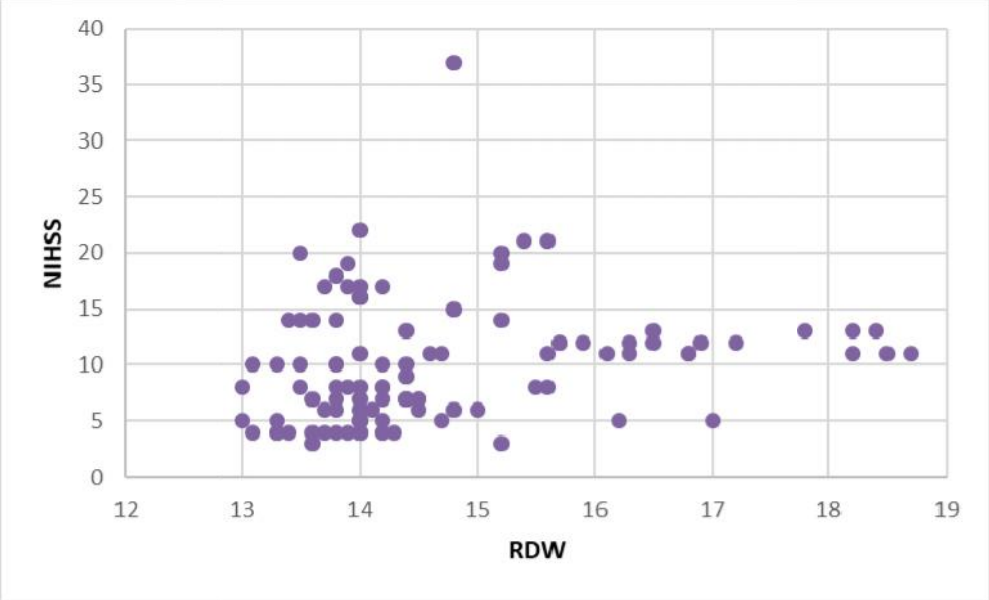


In our study population it was found that 63 % of the patients with acute ischemic stroke had high RDW (≥14%)

TABLE 5.11- CORRELATION BETWEEN RDW AND NIHSS

BETWEEN	r	p value
RDW and NIHSS	0.2061	0.0397

GRAPH 5.10 : CORRELATION BETWEEN RDW AND NIHSS

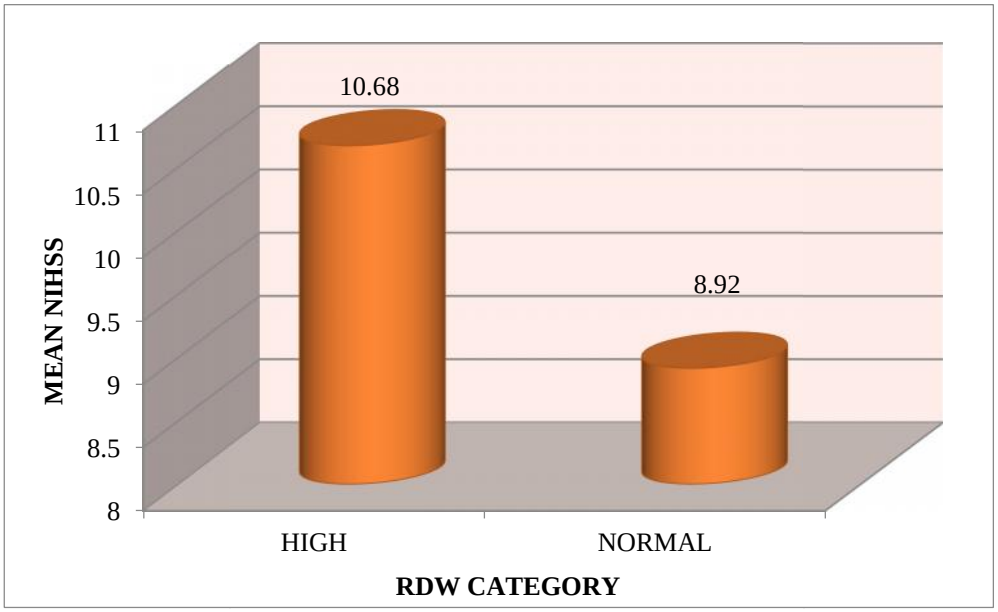


Above graph shows RDW and NIHSS have a positive correlation. Hence it can be inferred that higher the RDW values higher is the NIHSS score. In other words higher the RDW more severe is the stroke. This correlation is statistically significant with a p value of 0.0397 ($p<0.05$).

TABLE 5.12 - MEAN NIHSS IN DIFFERENT RDW CATEGORIES

	RDW					
	HIGH (n = 63)		LOW(n = 37)			
	MEAN	S.D.	MEAN	S.D.	p VALUE	INFERENCE
NIHSS	10.68	5.79	8.92	4.91	0.1238	NS

GRAPH 5.11 - MEAN NIHSS

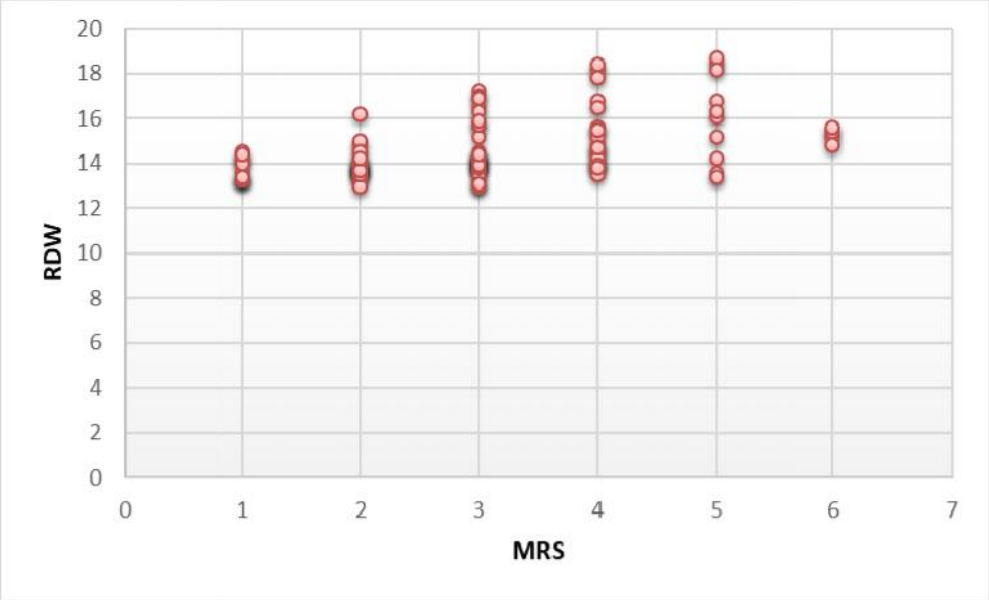


From the above table, it can be inferred that in patients with high RDW (>14), the mean NIHSS was higher(10.68) as compared to patients with normal RDW, in whom the mean was 8.92.However , this difference in means of NIHSS between the two groups of RDW was not statistically significant (p = 0.1238) .

TABLE 5.13- CORRELATION BETWEEN RDW AND mRS

BETWEEN	r	p value
RDW and MRS	0.4706	<0.0001

GRAPH 5.12 : CORRELATION BETWEEN RDW AND mRS

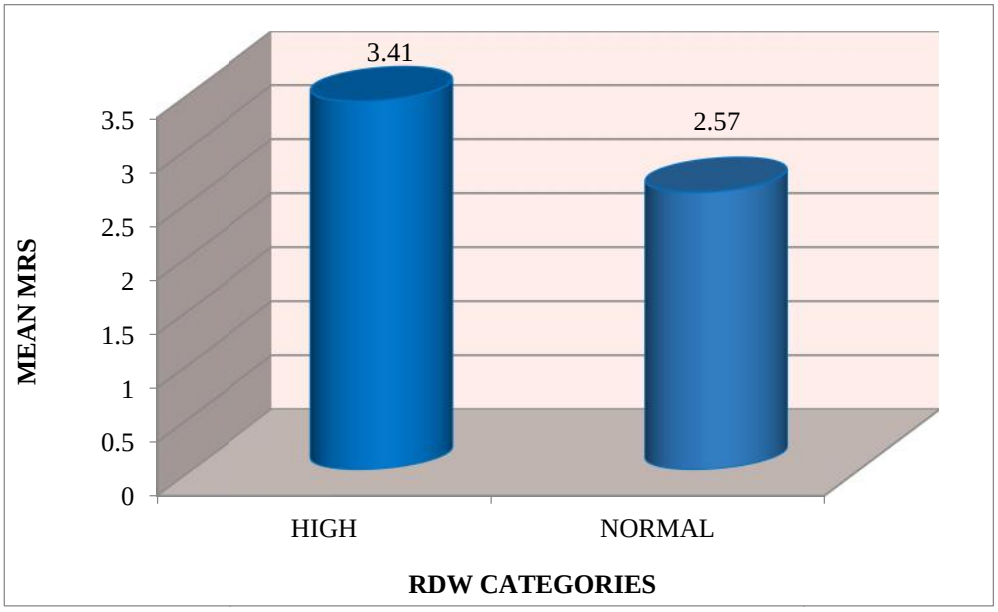


Above graph shows RDW and mRS have a positive correlation. Hence it can be inferred that higher the RDW values higher is the mRS score. In other words higher the RDW more is the disability after the stroke. This correlation is statistically significant (correlation coefficient r=o.4706) with a p value of 0.0001(p<0.05).

TABLE 5.14 - MEAN mRS IN DIFFERENT RDW CATERORIES

	RDW					
	HIGH (n = 63)		LOW(n = 37)			
	MEAN	S.D.	MEAN	S.D.	p VALUE	INFERENCE
MRS	3.41	1.29	2.57	1.04	0.0010	VS

GRAPH 5.13- MEAN mRS

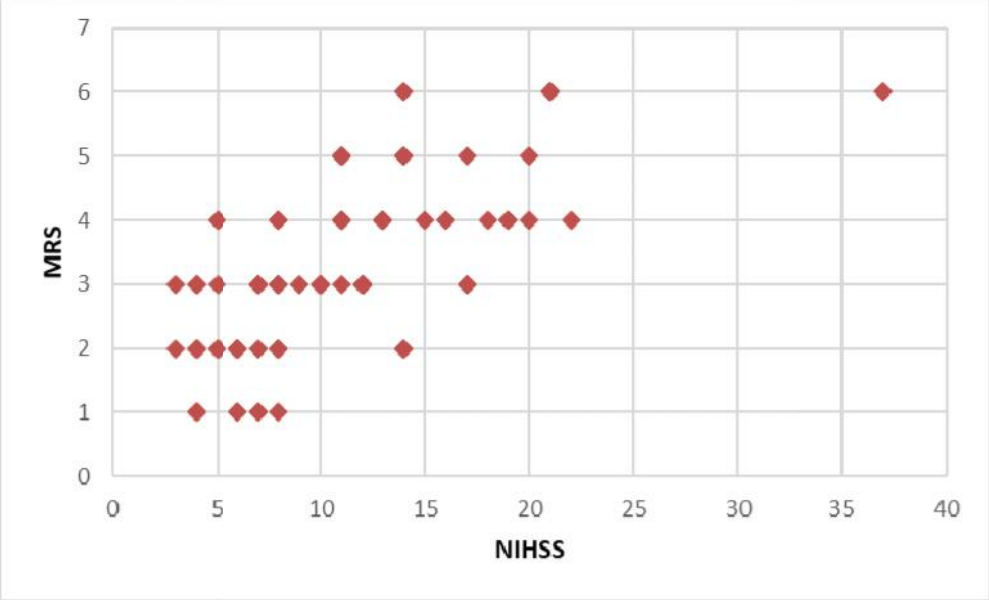


The above table depicts that in patients with high RDW (>14) , the mean mRS was higher (3.41) as compared to patients with normal RDW , in whom the mean was 2.57. This difference in means of mRS between the two groups of RDW was statistically significant (p = 0.001). This signifies that higher RDW was associated with high mRS .

TABLE 5.15- CORRELATION BETWEEN NIHSS AND MRS

BETWEEN	r	p value
NIHSS and MRS	0.6805	<0.0001

GRAPH 5.14 : CORRELATION BETWEEN NIHSS AND mRS



Above graph shows NIHSS and MRS have a positive correlation. Hence it can be inferred that higher the NIHSS values higher is the mRS score. In other words severe the stroke more is the disability after the stroke. This correlation is statistically significant (correlation coefficient r=0.6805) with a p value of 0.0001(<0.05).

DISCUSSION

We conducted a cross sectional study of 100 patients admitted with acute ischemic stroke at KLEs Dr Prabhakar Kore Hospital and Medical Research Centre with respect to demographic factors, comorbid conditions, severity of stroke and its comparison to clinical scoring systems for severity and outcome namely NIHSS and mRS. We correlated values of RDW of these patients with the clinical scoring systems.

In the present study maximum number of patients were in the age group >60 years, that is 41%.The youngest patient was 18 years old and the oldest was 90 years. The mean age of stroke was 56.88 ± 15.2. This is similar to the study done by Debasis Sarkar et al[95] which showed that the mean age for acute ischemic stroke was 61.84 ± 14.68. We also found that 24 patients came under stroke in young (<45 years) age group.

In the present study, out of 100 cases, 74% were males and 26% were females. Male preponderance was seen with Male to Female ratio of 2.85:1.00. This is in concordance with the study done by Nagaraja D et al wherein they found that male to female ratio was 2:1[96].

Hypertension was the most common comorbid condition (46%) found among patients in our study. This is in concordance with several hospital based and community-based studies[39,97]. In a study done by O'Donnell MJ, prevalence of hypertension in patients of acute ischemic stroke was 55% [39].

Diabetes Mellitus was the second most common comorbidity (43%) found among patients in our study. Where as in the Interstroke study done by O'Donnell MJ, the prevalence of Diabetes mellitus in patients of acute ischemic stroke was 21% [39].

In our study population of acute ischemic stroke patients 18% had history of coronary artery disease.

In our study tobacco chewing was seen in 44% of the patients making it the most common habit found among the patients with stroke. A study done by Dalal et al revealed that up to 40% of stroke patients in India had the habit of tobacco chewing[98]. The other common habits noted among the patients were smoking (27%) and alcohol consumption (25%). A study done by O'Donnell MJ revealed that the prevalence of smoking and alcohol consumption in Ischemic stroke patients was 37% and 31% respectively[39].

We studied RDW in 100 patients with acute ischemic stroke. Our study showed that 63% of the patients with acute ischemic stroke had high RDW with mean RDW being 14.68 %. This is consistent with the results of studies done by Kara et al and Kim et al, which showed that mean RDW in patients with acute ischemic stroke was 14.7%[12,99,100].

In this study we also looked at the association between RDW and the neurological scoring systems (NIHSS and mRS).

We found that a positive correlation exists between RDW and NIHSS (p value =0.0397) (severity of stroke). This is consistent with the study conducted by Kara et al, where it was found that a positive correlation exists between RDW and NIHSS in acute ischemic stroke patients (p value=0.009) [12]. Our study also found that the mean

NIHSS was on the higher side in the high RDW group when compared with the normal RDW group, however this difference in means was not statistically significant.

We studied the correlation between RDW and functional outcome in acute ischemic stroke patients graded by mRS. A positive correlation was found between RDW and mRS (p value <0.0001) suggesting that higher RDW was associated with poorer functional outcomes. This is in accordance with the study done by Kim et al where they concluded that RDW measured during an acute stroke (ischemic) period may be used as a biomarker for the prediction of long term outcome (p value=0.006) [13].

The results of the present study are in concordance with the findings of previous studies which showed that patients with acute ischemic stroke had high RDW. It also shows that high RDW is associated with increased stroke severity and poor functional outcome.

CONCLUSION

The present study was done on 100 patients who presented with stroke to the Department of General Medicine, KLES Dr. Prabhakar Kore hospital and MRC, Belagavi during the period Jan 2017 to Dec 2017.

The present study was conducted to determine various demographic factors, risk factors (modifiable and non-modifiable) associated with acute ischemic stroke and to study the relation between red blood cell distribution width and acute ischemic stroke and its correlation with severity and outcome of stroke .

- Our study found that acute ischemic stroke was common in the age group >60 years (41%). We also found that 24 patients (24%) came under the category of stroke in young (<45 years) age group.

- In our study population, the incidence of acute ischemic stroke was more in males compared to females (2.85:1)

- Study of the risk factors associated with acute ischemic stroke revealed that hypertension was found in 46% of the patients, diabetes was seen in 43% of the patients, history of TIA was present in 22% of the patients, history of coronary artery disease was present in 18% of the patients.

- We also found that in our study population, tobacco chewing was a major risk factor which was seen in 44% of the patients. The other risk factors included smoking (27%) and alcohol consumption (25%).

- In our study population it was found that 63 % of the patients with acute ischemic stroke had high RDW (≥14%).

- Correlation of RDW with severity of stroke as determined by NIHSS was studied using Pearson's correlation co-efficient. This positive correlation(r=0.2061) was found to be statistically significant (p value = 0.0397).

- We also studied correlation of RDW with outcome of stroke as determined by Modified Rankin Score (mRS) . We found that there was a positive correlation(r=0.4706) between RDW and mRS and this correlation was statistically significant.

SUMMARY

The present study was done on 100 patients who presented with ischemic stroke to the Dept of Medicine, KLES Dr Prabhakar Kore hospital and MRC, Belagavi during the period Jan 2017 to Dec 2017.

1. In our study we found that Red cell Distribution Width (RDW), a widely used and inexpensive test, was higher in patients with acute ischemic stroke.

2. The study also shows that higher RDW was significantly associated with severity of stroke and disability of stroke.

Therefore, RDW is a strong predictor for stroke severity and disability.

Further studies on a larger population are required to evaluate and validate this correlation.

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ANNEXURE I – CONSENT FORM

INFORMED CONSENT FORM

A STUDY OF RED BLOOD CELL DISTRIBUTION WIDTH IN ACUTE ISCHEMIC STROKE PATIENTS- A ONE YEAR CROSS SECTIONAL STUDY AT KLE'S DR.PRABHAKAR KORE HOSPITAL AND MRC

Objective and purpose of the study:

1. To study levels of red blood cell distribution width in acute ischemic stroke patients.
2. To evaluate the correlation between the red blood cell distribution width with severity of acute ischemic stroke as assessed by National Institutes Of Health Stroke Scale (NIHSS).
3. To evaluate the correlation between the red blood cell distribution width with outcome of acute ischemic stroke as assessed by Modified Rankin Scale.

The principal investigator of the study is Dr. Abhilash B. Mareguddi under the guidance of Dr .RekhaS.Patil.

Procedure:

If you agree to be part of the research study you will be asked the relevant history in relation to stroke and will be subjected to blood investigations like red cell distribution width.

Risk and Benefits:

There is no risk associated with study.

Alternatives:

Taking part in this study is voluntary. You may choose not to take part in this study, or 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 sponsorer may stop your participation in this study 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

VOLUNTARY PARTICIPATION/ WITHDRAWAL:

Your participation in this study is entirely voluntary and you may withdraw from the study at any time. 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, Belgaum as part of requirement towards the completion of MD degree, review and publishing.

QUESTIONS:

In case of queries regarding your right as a participant you may contact:

DR. GANGA PILLI,

Chairman,

J.N.M.C Ethical Committee for Human Research,

Professor, Department of Pathology, JNMC Belgaum

Phone number: 0831-2471350.

Extn: 1527

CONSENT FORM

I voluntarily agree to take part in this study by signing on the line below. I may withdraw at any time. I am not giving up any of my legal rights by signing this form. My signature below indicated that I have read this entire consent form or it has been read to me, and has been explained to me in my vernacular language and had all my questions 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's : …….

Signature/ Left Thumb Impression. : …….

Witness's Name : …….

Signature/ Left Thumb Impression. :…….

Investigators name and Signature : …….

Date and Place : …….

ANNEXURE-II

PROFORMA FOR A STUDY OF RED BLOOD CELL DISTRIBUTION WIDTH IN ACUTE ISCHEMIC STROKE PATIENTS- A ONE YEAR CROSS SECTIONAL STUDY AT KLE'S DR. PRABHAKAR KORE HOSPITAL AND MRC

2 NAME:

3. AGE:

4. SEX

5. OCCUPATION:

6. RELIGION:

7. I.P. NO./O.P. NO.:

8. ADDRESS:

9. DATE OF ADMISSION: 10.DATE OF DISCHARGE:

11. OUTCOME :

HISTORY:

PRESENTING COMPLAINTS

HISTORY OF PRESENTING ILLNESS:

PAST HISTORY:

Significant personal history:

Significant family history

TREATMENT HISTORY:

Received any treatment for similar complaints in the past

GENERAL PHYSICAL EXAMINATION

Pallor: Yes/No

Icterus: Yes/No

Lymphadenopathy: Yes/No

Cyanosis: Yes/No

Clubbing: Yes/No

Edema: Yes/No

Vital signs:

Pulse

Blood Pressure

SYSTEMIC EXAMINATION:

R. S.:

C.V.S.:

P.A.:

C.N.S.:

1. National Institutes of Health Stroke Scale (NIHSS).

Level of Consciousness
- Alert (0 points)
- Not alert, but arousable with minimal stimulation (1 point)
- Not alert, requires repeated stimulation to attend (2 points)
- Coma (3 points)

Patient Knows Month and Own Age
- Answers both correctly (0 points)
- Answers one correctly (1 point)
- Both incorrect (2 points)

Patient Opens and Close Eyes on Command
- Obeys both correctly (0 points)
- Obeys one correctly (1 point)
- Both incorrect (2 points)

Best Gaze (only horizontal eye movement)
- Normal (0 points)
- Partial gaze palsy (1 point)
- Forced deviation (2 points)

Visual Field testing
- No visual field loss (0 points)
- Partial hemianopia (1 point)
- Complete hemianopia (2 points)
- Bilateral hemianopia (blind including cortical blindness) (3 points)

Facial Paresis (Ask patient to show teeth or raise eyebrows and close eye
- Normal symmetrical movement (0 points)
- Minor paralysis (1 point)
- Partial paralysis (total or near total paralysis of lower face) (2 points)
- Complete paralysis of one or both sides (3 points)

Motor Function of Right Arm
- Normal (0 points)
- Drift (1 point)
- Some effort against gravity (2 points)
- No effort against gravity (3 points)
- No movement (4 points)
- Untestable* (0 points)

Motor Function of Left Arm
- Normal (0 points)
- Drift (1 point)
- Some effort against gravity (2 points)
- No effort against gravity (3 points)
- No movement (4 points)
- Untestable* (0 points)

Motor Function of Right Leg
- Normal (0 points)
- Drift (1 point)
- Some effort against gravity (2 points)
- No effort against gravity (3 points)
- No movement (4 points)
- Untestable* (0 points)

Motor Function of Left Leg
- Normal (0 points)
- Drift (1 point)
- Some effort against gravity (2 points)
- No effort against gravity (3 points)
- No movement (4 points)
- Untestable* (0 points)

Limb Ataxia
- None (0 points)
- One limb (1 point)
- Two Limbs (2 points)

Sensory by Pinprick
- Normal (0 points)
- Mild to moderate decrease in sensation (1 point)
- Severe to total sensory loss (2 points)

Language
- No aphasia (0 points)
- Mild - Moderate aphasia (1 point)
- Severe aphasia (2 points)
- No speech production (3 points)

Dysarthria
- None (0 points)
- Mild - Moderate slurring (1 point)
- Severe (2 points)
- Intubated or other physical impediment to testing (0 points)

Extinction and Inattention
- Normal (0 points)
- Inattention or extinction to bilateral simultaneous stimulation in one of the sensory modalities (1 point)
- Severe hemi-inattention or hemi-inattention to more than one modality (2 points)

Results:

Total Criteria Point Count: 0

2. Modified Rankin Scale (mRS).

Score	Definition
0	No symptoms
1	No significant disability. Able to carry out all usual activities, despite some symptoms
2	Slight disability. Able to look after own affairs without assistance, but unable to carry out all previous activities
3	Moderate disability. Requires some help, but able to walk unassisted
4	Moderately severe disability. Unable to attend to own bodily needs without assistance, and unable to walk unassisted
5	Severe disability. Requires constant nursing care and attention, bedridden, incontinent
6	Dead

Red cell distribution width (RDW):

CT BRAIN/MRI BRAIN:

ANNEXURES III - MASTER CHART

SL.NO	IP NO.	NAME	AGE	GENDER	HYPERTENSION	DIABETES MELLITUS	TIA	IHD	RDW	HIGH RDW	HEMOGLOBIN	RBC COUNT	TOTAL COUNT	PLATELETS	MPV	NIHSS	MRS	TOBACCO	SMOKING	ALCOHOL
1	865078	RAJARAM APPA CHOUGULE	43	M	N	N	N	N	14.0	1	15.9	5.04	10500	2.64	11.1	22	4	0	0	1
2	864909	NEELAMAMA GURUSIDDAPA CHIKAMATH	49	F	N	N	N	N	15.2	1	15.2	5.49	8000	3.36	9.6	3	3	0	0	0
3	865162	BASAVARAJ SADAPPA PARAVATI	55	M	Y	N	Y	Y	13.3	0	13.8	5.20	9100	2.19	11.4	5	2	1	1	1
4	864443	RUDRAVVA GANGAPPA ROTTI	65	F	Y	Y	N	N	14.0	1	13.2	4.60	14700	2.4	13.4	17	3	1	0	0
5	863731	MUSA CHANDSAB YADGAUNKAR	45	M	N	N	N	N	14.8	1	14.3	3.86	14700	1.87	11.8	15	4	1	0	0
6	**863446**	MALLAWA	82	F	N	Y	N	Y	13.6	0	12.2	4.14	9900	1.67	9.4	7	2	1	0	0
7	778372	SONABAI	50	F	N	Y	N	N	14.4	1	12.1	4.19	10100	2.55	10.6	13	4	0	0	0
8	769551	RANIDEVI	50	F	N	N	N	N	14.0	1	12.5	4.82	15200	3.06	8.8	8	3	0	0	0
9	864304	HANAMAVVA	65	F	N	Y	Y	N	15.2	1	13.2	4.33	9900	4.61	12.2	19	4	1	0	0
10	829755	SHANJAR BHIMAPPA AJURE	80	M	Y	N	N	Y	14.2	1	12.6	4.10	8500	1.64	8.4	8	3	1	0	0
11	828121	MAHADEVAPPA YALLAPA BETAGAR	65	M	Y	N	N	N	14.0	1	12.1	4.04	6200	1.9	9.8	16	4	0	0	1
12	865864	TUKARAM KRISHNA PATIL	60	M	Y	N	Y	N	13.8	0	12.5	3.85	7800	3.24	8.0	4	2	1	1	0
13	861131	AOUMA KASHIMSAB AKKIWAT	75	M	Y	Y	N	Y	14.6	1	12.6	3.60	9600	3.65	8.9	11	4	0	1	0
14	861165	MARUTI PATAT	55	M	N	Y	N	N	14.2	1	14.1	4.80	13300	3.76	10.4	17	5	1	0	0
15	858583	NISAR MULLAA	25	M	N	N	N	N	13.8	0	16.6	5.80	9800	1.64	9.4	10	3	1	0	0
16	848608	DHEMAPPA	30	M	N	N	N	N	14.0	1	17.1	5.89	13800	2.41	8.2	5	2	0	0	1
17	855245	SHANKAR MAHADEV BANNE	63	M	N	Y	Y	Y	14.4	1	12.2	3.50	9900	3.45	7.8	9	3	1	1	0

18	849295	SANTOSH SADASHIV	43	M	N	Y	N	N	13.6	0	14.6	3.71	14900	2.6	8.4	3	2	0	1	1
19	848569	YALLAPA BASAPPA RAMANNAVAR	65	M	Y	Y	Y	Y	14.2	1	12.4	3.17	16400	2.62	7.9	8	1	1	0	0
20	866328	RAVI PATIL	58	M	N	N	N	N	15.2	1	14.8	5.20	9100	5.41	8.4	14	6	0	0	0
21	866254	SHIVANAND KHAVASHI	50	M	Y	Y	N	N	14.0	1	14.3	5.33	12100	3.69	8.9	4	2	0	1	1
22	866441	ADIVAYYA	65	M	N	N	Y	N	14.3	1	12.1	4.73	16.7	5.1	7.9	4	2	1	1	0
23	866447	SUBHASH	55	M	N	Y	N	Y	14.5	1	15.1	4.85	19000	3.43	9.5	7	1	0	1	0
24	861371	MALLIKARJUN	47	M	N	N	N	N	15.4	1	13.5	4.75	10900	2.3	9.2	21	6	1	0	0
25	866347	SUDARSHAN JINADATTA INGALE	48	M	Y	N	N	N	13.8	0	15.3	4.96	9300	2.62	8.5	10	3	0	0	0
26	861245	SUNIL RAGHUNATH JORAPUR	42	M	N	N	N	N	14.2	1	13.0	4.77	12400	2.19	9.8	10	3	1	1	0
27	867295	GIRIMALADAPPA	45	M	N	N	N	N	14.1	1	13.2	4.54	4530	1.11	7.8	6	1	0	1	1
28	866523	HASHAM ABDUL SATTAR	61	M	N	Y	N	N	14.0	1	14.6	2.49	8160	2.49	10.4	5	2	0	0	0
29	857526	NARAYAN DEVAPPA SHINDE	64	M	Y	Y	N	N	13.9	0	15.5	5.01	6700	2.23	8.5	4	2	0	1	1
30	863705	SUBARAO NAGOJI OLOKAR	78	M	Y	N	Y	Y	14.0	1	13.9	4.59	5400	1.4	9.2	4	3	1	0	0
31	868541	SIDDRAM GHANDAGE	60	M	N	N	N	N	14.0	0	16.2	5.51	11300	2.7	9.0	7	3	1	0	0
32	868216	ISHWAR YANKAPPA SIDDANAVAR	56	M	N	Y	N	N	18.5	1	14.8	3.73	18900	2.29	9.5	11	5	1	1	1
33	868773	VEERBHADRAYYA SHIVAMURTAYYA HIREMATH	60	M	N	N	N	N	13.0	0	12.2	4.19	11400	2.19	10.1	5	2	0	0	0
34	869077	CHIDANAND BASAVENNEPA BHUSHI	75	M	Y	N	Y	Y	13.0	0	14.2	4.83	9200	1.96	9.4	8	3	0	0	1
35	868323	SHASHIDHAR NARAYAN NAIK	37	M	N	N	N	N	15.6	0	17.0	5.81	6700	2.44	7.6	8	4	1	1	1
36	869244	GANGAWWA RAMAPPA NAIKWADI	67	F	Y	N	Y	N	13.6	0	12.9	4.59	11900	3.15	9.6	14	5	0	0	0
37	869031	SUDER RAJ SULHAPPA	47	M	N	N	N	N	13.8	0	16.2	5.22	13300	3.06	10.6	6	2	0	1	0
38	869041	NEETA DATTATRAYA PATIL	52	F	Y	N	N	Y	13.3	0	11.3	4.14	6400	2.61	10.2	10	3	0	0	0
39	868983	RAMIJAN	32	F	N	N	N	N	15.7	1	12.6	4.59	11400	3.53	12.4	12	3	1	0	0
40	869421	BIBIJAN	60	F	Y	Y	Y	Y	14.8	1	12.4	3.59	6000	1.54	10.6	6	2	0	0	0
41	868772	ANANT	55	M	N	Y	N	N	13.8	0	15.0	5.58	6000	2.13	9.4	8	2	1	0	1
42	853734	BABRAM	53	M	Y	N	N	N	13.3	0	16.4	5.30	12200	2.06	7.8	4	1	0	0	0
43	852525	BASAVANTEP	68	M	N	N	Y	N	14.0	1	16.3	5.27	10400	1.86	13.0	16	4	1	0	0
44	853119	BABASAHEB	68	M	Y	Y	N	N	13.7	0	12.2	3.92	8100	1.96	8.5	17	3	1	1	1
45	854116	SHANTA	70	F	N	N	N	N	14.2	1	14.6	4.75	10300	2.98	7.5	5	4	1	0	0

46	854199	BABURAO	79	M	Y	N	Y	Y	15.2	1	15.3	5.90	12700	2.73	12.6	20	5	0	1	1
47	854998	AYUB	59	M	N	Y	N	N	13.9	0	13.0	4.68	14900	1.72	10.6	19	4	1	1	0
48	855791	RATNAPPA	90	M	N	N	N	N	13.5	0	14.9	4.38	12500	2.46	8.2	14	2	1	0	0
49	855697	KEMPANNA	30	M	N	N	N	N	14.0	0	16.1	5.06	16900	2.53	8.8	11	3	1	0	0
50	855708	SAVITRABAI	78	F	Y	Y	N	N	18.2	1	12.1	4.08	15700	1.57	12.1	13	4	1	0	0
51	848780	SHANKUNTALA	67	F	Y	N	Y	N	15.0	1	13.1	4.59	11600	3.53	8.7	6	2	0	0	0
52	849324	PARVATI	32	F	N	N	N	N	14.8	1	15.0	5.01	13700	4.25	6.9	37	6	0	0	0
53	851965	SOPHIE	83	F	Y	Y	N	Y	13.5	0	12.8	4.27	11400	1.66	12.5	20	4	0	0	0
54	852681	SHASHIKALA	76	F	N	Y	Y	N	13.8	0	14.6	5.13	12.7	2.93	7.4	18	4	1	0	0
55	851265	KASHAWWA	60	F	Y	Y	N	N	16.1	1	13.2	5.62	9800	4.18	8.6	11	5	0	0	0
56	851568	MALLIKARJUN	73	M	Y	N	N	Y	16.2	1	14.3	4.40	10400	2.11	9.7	5	2	1	0	1
57	851228	JEEVAPPA	73	F	Y	Y	Y	N	14.7	1	12.0	3.94	8.8	2.48	9.0	11	4	0	0	0
58	821239	CHINNAPA	52	M	Y	N	N	N	13.1	0	16.2	5.13	8300	3.23	8.6	10	3	0	0	0
59	821107	SHRIKANT	42	M	Y	N	N	N	18.7	1	15.8	6.02	25100	3.41	9.8	11	5	0	1	1
60	821423	BHARAT	52	M	N	N	N	N	14.2	1	13.8	5.17	12400	3.28	7.9	7	3	1	0	0
61	821497	SUNIL	44	M	N	N	N	N	13.6	0	13.5	4.33	7300	2.87	8.9	4	1	0	0	0
62	822461	BASU	65	M	Y	N	Y	Y	14.5	1	12.4	4.24	14100	3.74	8.4	7	3	0	1	0
63	822666	KEDARI	68	M	Y	Y	N	N	16.5	1	14.9	4.80	15900	2.43	10.3	12	3	1	0	1
64	823124	BIBI ZAHEER	65	F	N	Y	N	N	15.6	1	12.5	4.76	15300	5.36	8.9	11	4	1	0	0
65	824797	RADHA	45	F	N	N	Y	N	18.2	1	13.0	4.72	8100	2.46	8.0	11	5	1	0	0
66	827469	DAYANAND	73	M	Y	Y	N	Y	13.3	0	13.8	4.24	10800	3.44	8.2	4	1	1	0	0
67	830564	BASAVARAJ	47	M	N	Y	N	N	17.2	1	13.4	4.08	9200	3.57	6.5	12	3	0	0	1
68	831201	APPANA	80	M	Y	Y	Y	Y	13.9	0	14.7	5.41	10500	2.76	10.9	8	2	0	0	0
69	832064	ASHWINKUMAR	62	M	Y	Y	N	N	13.7	0	15.1	4.25	10300	2.42	7.8	6	2	0	0	0
70	833317	SURESH	42	M	N	N	N	N	14.4	1	12.6	3.04	5100	1.58	8.8	10	3	0	1	1
71	833473	BALLAPA	82	M	Y	N	N	N	13.3	0	14.6	4.75	7200	1.2	10.6	4	1	1	1	0
72	835959	RAMACHANDRA	44	M	N	N	N	N	14.2	1	13.4	4.32	8100	1.68	9.9	4	3	0	0	0
73	836001	KALLAWA	65	F	N	Y	Y	N	13.5	0	12.3	4.02	10900	3.32	7.8	10	3	0	0	0

74	836259	SHIVAPUTRAPA	56	M	Y	N	N	Y	16.3	1	12.7	6.01	7700	2.35	9.3	12	3	0	0	0
75	836876	DANNAYYA	18	M	N	N	N	N	16.8	1	14.3	4.77	10700	2.77	9.5	11	4	1	1	1
76	836956	MALAGOUDA	65	M	Y	Y	N	N	15.6	1	13.8	5.18	14500	5.33	7.9	21	6	0	0	0
77	838083	BHAIRU	70	M	Y	N	Y	Y	13.8	0	14.2	5.00	5900	2.69	9.4	14	2	0	0	0
78	838559	SHEVANTA	76	F	Y	Y	N	N	17.0	1	12.2	4.19	12900	3.77	8.7	5	3	0	0	0
79	839528	RUDRAPPA	80	M	N	Y	N	N	16.5	1	13.5	4.42	4000	2.28	8.1	13	4	0	0	0
80	839176	BHIMASHI	18	M	N	N	N	N	14.7	1	12.6	4.68	22200	4.36	6.5	5	4	0	1	1
81	839698	AJIT	39	M	N	N	N	N	14.5	1	14.9	4.58	10200	2.53	8.9	6	2	0	0	0
82	840855	RAMESH	41	M	N	Y	N	N	16.9	1	13.2	5.12	9700	3.6	8.9	12	3	0	1	1
83	839769	RAMAGOUDA	63	M	Y	Y	N	Y	13.5	0	12.8	4.04	20200	1.83	10.4	8	2	0	0	0
84	841737	MANGALA	43	F	N	N	Y	N	18.4	1	12.2	4.06	10100	3.4	7.0	13	4	1	0	0
85	841448	GADIGEPPA	70	M	Y	N	N	N	13.1	0	15.2	5.01	16000	3.47	8.9	4	3	0	0	0
86	841880	SURESH	60	M	Y	Y	N	N	13.4	0	13.7	4.70	13100	2.72	7.2	14	5	0	0	1
87	845761	HANAMAVVA	60	F	N	Y	N	N	15.5	1	12.3	4.74	10600	2.8	7.9	8	4	1	0	0
88	846198	SHIVAJI	55	M	Y	N	N	Y	16.8	1	12.8	4.54	23200	3.05	9.4	11	5	1	0	0
89	846544	MOHAMMAD ALI	55	M	N	N	N	N	13.8	0	15.2	5.36	10700	2.24	8.7	7	3	1	0	0
90	846411	GOUSAB	68	M	Y	Y	N	Y	13.7	0	13.8	4.67	12800	3.91	7.7	4	2	0	0	0
91	848722	LAKKAVVA	25	F	N	N	N	N	13.4	0	13.3	4.96	9500	2.27	10.5	4	1	0	0	0
92	848598	KALKANGOUDA	55	M	Y	Y	N	N	14.2	1	14.3	4.31	5000	1.93	7.1	4	2	0	1	0
93	849630	MAHADEV	27	M	N	N	N	N	14.0	1	13.7	4.45	12700	2.33	8.3	6	1	0	0	0
94	848519	BAHABULI	46	M	N	Y	N	N	17.8	1	12.5	4.28	6700	4.23	9.0	13	4	1	1	0
95	848222	CHETAN	18	M	N	N	N	N	16.3	1	12.9	4.40	10700	3.35	10.1	11	5	1	0	0
96	849790	SHRIMANTH	55	M	Y	N	Y	Y	15.7	1	16.3	5.26	17000	1.62	10.1	12	3	0	0	1
97	849930	MAHADEV	77	M	Y	Y	N	N	13.9	0	15.7	4.99	8200	2.01	11.1	17	3	1	0	1
98	849160	MALLIKARJUN	70	M	N	Y	N	Y	14.4	1	12.3	4.26	8700	2.59	8.4	7	3	1	0	0
99	851168	GOUS	52	M	Y	N	N	N	15.9	1	17.0	5.55	12900	2.95	7.8	12	3	0	1	0
100	851964	SHANTA	60	F	Y	Y	N	Y	14.4	1	13.4	4.27	7600	2.15	8.5	7	1	0	0	0

ANNEXURE-IV

KEY TO MASTER CHART

A – SL.NO – SERAL NUMBER

B – IP NO. –INPATIENT NUMBER

C – NAME

D – AGE (in years)

E – GENDER –M-MALE,F-FEMALE

F – HTN-HYPERTENSION – N-NO,Y-YES

G – DM-DIABETES MELLITUS – N-N0, Y-YES

H – TIA-TRANSIENT ISCHEMIC ATTACK – N-NO,Y-YES

I – IHD-ISCHEMIC HEART DISEASE – N-NO,Y-YES

J – RDW-RED CELL DISTRIBUTION WIDTH

K – HIGH RDW- 1 >14% 0<14%

L – Hb-HEMOGLOBIN

M – RBC COUNT

N – TOTAL COUNT

O – PLATELET

P – MPV-MEAN PLATELET VOLUME

Q – NIHSS-NATIONAL INSTITUTE OF HEALTH STROKE SCALE

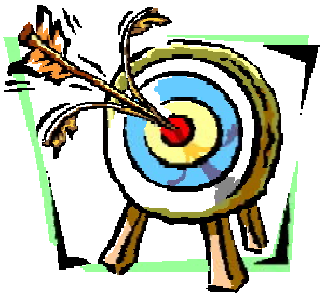
R – mRS-MODIFIED RANKIN SCORE

S – TOBACCO

T – SMOKING

U – ALCOHOL

Introduction



Objectives

Review of Literature

Methodology

Results

Discussion

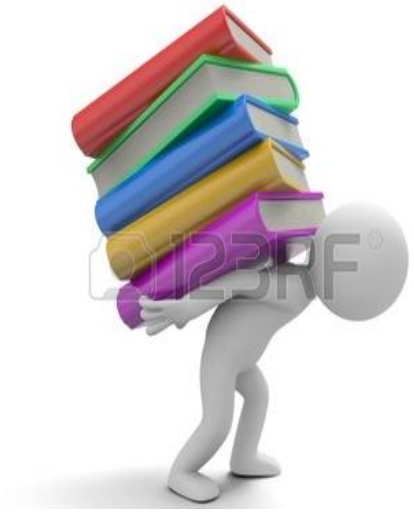
Conclusion

Summary

Bibliography

Annexure-I

Annexure-II



Annexure-III

Annexure-IV