PREDICTORS OF EARLY MORTALITY IN ANTERIOR CIRCULATION STROKE

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CERTIFICATE

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DECLARATION

I solemnly declare that this dissertation entitled **"PREDICTORS OF EARLY MORTALITY IN ANTERIOR CIRCULATION STORE"** was done by me at Madras Medical College and Govt. General Hospital during 2004-2007 under the guidance and supervision of **Prof. V. RAJI, M.D.** This dissertation is submitted to the Tamil Nadu Dr.M.G.R. Medical University towards the partial fulfillment of requirements for the award of M.D. DEGREE IN GENERAL MEDICINE (BRANCH - I).

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CONTENTS

INTRODUCTION

Globally, Stroke is the third leading cause of death preceded only by cardiac disease and malignancy[1]. The incidence of stroke increases with age. It is a major cause of disability also. As the elderly population grows with improved health care, it is projected that stroke related deaths will double by 2030[1]. A thorough knowledge by the treating physician on aetiopathology, risk factors and management of strokes will help in reducing stroke related mortality.

Stroke, or cerbrovascular accident (CVA)[2] by definition is a syndrome of 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 of vascular origin.

The world wide incidence of stroke has been quoted as 2/1000 population/annum; about 4/1000 in people aged 45-84 years[3]. In India the incidence of cerbrovascular disease was found to be 13/100,000 population/ year in a study conducted at Vellore in 1969-71 and 33/100,000 / year in a study conducted at Rohtak. A WHO study, in 1990 quoted incidence of mortality due to stroke in India to be 73/100,000 per year).[4]

In urban India, stroke accounts for 1% mortality of all hospital admissions, 4% of all medical cases and about 20% of all the disorders

of central nervous system.[5] Case fatality rates after a first ever stroke (all types) are: [6]

12% - 7 days

19% - 30 days

31% - 1 year

About 20% of those with first ever stroke will be dependent on another person for everyday activities at 12 months while 50% will be independent. The prognosis is worse for a second stroke.

It is rather difficult to prognosticate outcome/mortality when a patient comes to a physician with a fully evolved or an evolving stroke. No rules have yet been formulated that allow one to predict the early course with confidence.

Several factors influence the prognosis in CVA. In very large infarcts, swelling of the infracted tissue may occur, followed by displacement of cerebral structures, tentorial herniation and death of the patient. This can be anticipated by the sheer volume of the infarct and is usually evident on the CT scan within a day of stroke. Smaller lesions on the inferior surface of the cerebellum may also cause a fatal herniation into the foramen magnum.

Many possibilities exist for eventual or long term prognosis. Improvement is the rule if patient survives. So, it becomes necessary to identify the predictors of early mortality in a patient with stroke.

Many scoring systems have been developed to predict the outcome of stroke. The widely used NIH Stroke scale[7], Canadian Neurological scale[8]

assess the severity of stroke based on clinical factors and the modified Rankin scale deals with the functional aspects of stroke patients. The immediate outcome for a patient after a cerebrovascular accident can be predicted using a prognostic score based on early clinical findings. This score was developed by Dr.Rodrigues and Joshi in India at the BYL Nair Hospital in Mumbai.[9] Bandolier prognostic index[10] is another such scoring system to predict early mortality.

This study has attempted, to identify the factors which predict early mortality in stroke and to evaluate the utility of these two scoring systems and compare results obtained by these two systems.

AIMS AND OBJECTIVES

To assess and evaluate the significance of common clinical parameters as independent indices of mortality in stroke.

To evaluate and correlate Rodrigues and Joshi's prognostic score with Bandolier's prognostic index as predictors of early mortality in stroke victims.

REVIEW OF LITERATURE

Cerebrovascular diseases may be classified into thrombotic, embolic and hemorrhagic events. The frequency of the different types of cerebrovascular diseases has been difficult to ascertain. Harvard Cooperative stroke registry tabulated in 1978, comprised 756 successive patients each of whom was examined by a physician as follows:

Thrombosis	-	32%
Lacunar infarcts	-	18%
Embolism	-	32%
Hemorrhage	-	11%
Ruptured Aneurysm & AVM	-	7%

The classification of stroke by the Oxford shire Community stroke sub classification system as given below allows us to decide about investigation and predict the prognosis.[11,12]

1. Total anterior circulation syndrome (TACS)
2. Partial anterior circulation syndrome (PACS)
3. Lacunar syndrome
4. Posterior circulation syndrome

TOTAL ANTERIOR CIRCULATION STROKE

The total anterior circulation syndrome (TACS), implies a large cortical stroke in middle and anterior cerebral artery territories. It is characterised by combination of new higher cerebral dysfunction and homonymous visual field

defect and an ipsilateral motor and / or sensory deficit involving at least two out of three areas of the face, arm and legs.

PARTIAL ANTERIOR CIRCULATION SYNDROME (PACS)

This implies a cortical stroke in middle or anterior cerebral territory. They are the patients with two out of three components of the TACS or new higher cerebral dysfunction alone or a motor/sensory deficit more restricted than those classified as TACS.

LACUNAR SYNDROME

This implies sub cortical stroke due to small vessel disease which includes

- Pure Motor Stroke
- Pure Sensory Stroke
- Sensory Motor Stroke and
- Ataxic Hemiparesis

Evidence of higher cortical dysfunction or disturbance of consciousness excludes a lacunar syndrome.

POSTERIOR CIRCULATION STROKE

This includes syndromes which arise due to lesions in areas supplied by the vertebral and basilar arteries.

- Isolated cranial nerve palsy with contralateral motor and/or sensory deficit.

- Bilateral Motor / sensory deficit
- Disorders of conjugate eye movements
- cerebral dysfunction without ipsilateral long tract involvement
- Isolated homonymous visual field defects
- Cerebellar involvement.

ACUTE STROKE PHASE

The advantage of admitting an acute stroke patient in a neurological special care or 'stroke unit' has been the subject of many articles. [13, 14, 15, 16] The general opinion is that the outcome in terms of mortality and morbidity has improved considerably.

The prevalence of hypertension following an ischemic stroke has been confirmed by several studies and it has a tendency to decline within a few days. Anti hypertensive drugs may be avoided in the first few days unless it poses a risk to other organs, particularly the kidneys. The patient should remain horizontal in bed for the first day to maintain an adequate cerebral perfusion.[17] Timely intubation protects the airway and prevents aspiration.

CEREBRAL EDEMA AND RAISED ICT

In the first few days following massive cerebral infarction, edema (both vasogenic and cellular) of the necrotic tissue may threaten life. The clinical deterioration occurs within several days of onset, usually worst on the third day.[18] Surgical procedures like hemicraniectomy combined with an overlying duroplasty or 'strokectomy' - removing infarcted tissue and replacing the cranial bone flap are not widely done.[19]

PROGNOSIS IN STROKE

The following are the factors predicting poor outcome, in stroke:[20]

1. Age : >75
2. Male sex
3. Risk Factors : AF, DM, Previous Stroke

Clinical Features

4. Decreased consciousness at the onset
5. Presence of gaze deviation
6. Headache nausea, vomiting in first 24 hours.
7. Elevated systolic BP > 180mm Hg on first day
8. Hyperthermia on admission
9. Large vessel disease

Laboratory Findings

10. High glutamate levels in plasma > 200 micromoles/L
11. CRP >10.2 mol within 72 hrs
12. Hyperglycaemia >7 mmol/L
13. Platelet count <150,000

Neuro imaging studies

14. Hyper density in a major intra cranial artery
15. Early CT Changes within 6 hours of onset
16. >33% of MCA territory involvement

17. Multiple territory involvement with mass effect
18. Haemorrhagic transformation on follow up CT
19. Persisting MCA occlusion of > 8 Hrs on TC Doppler
20. No flow on SPECT perfusion patterns
21. Carotid Artery, MCA, Basilar Artery occlusion on conventional angiogram.
22. MRI - abnormal PWI in diffusion studies.
23. MRA - absence of MCA.

COPENHAGEN STROKE STUDY[21]

Most severe strokes accounted for 20 percent of the total stroke population in this study. The majority of those people died from their stroke and more than half of the survivors remained severely disabled. This study evaluated the prognostic importance of various stroke characteristics and social, demographic and medical factors in patients with most severe strokes. Those who had a Scandinavian stroke scale (SSS)[22,23] on acute admission <15 and those who survived were included. These patients were stratified into 2 groups

1. Those who eventually had a good functional outcome ie Barthel [24, 25] Index BI≥ 50

2. Those who had a poor functional outcome i.e. BI < 50 after complete rehabilitation. The details of the scale and Barthel index are given below.

SCANDINAVIAN STROKE SCALE

	FUNCTION	SCORE
1.	**Consciousness**	
	- fully conscious	6
	- somnolent, can be awaked to full consciousness	4
	- reacts to verbal command, but is not fully conscious	2
	- Coma	0
2.	**Eye Movement**	
	- no gaze palsy	4
	- gaze palsy present	2
	- conjugate eye deviation	0
3.	**Arm, Motor Power**	
	- raises arm with normal strength	6
	- raises arm with reduced strength	5
	- raises arm with flexion of elbow	4
	- can move, but not against gravity	2
	- paralysis	0
4.	**Hand, Motor Power**	
	- normal strength	6
	- reduced strength in full range	4
	- some movement, fingertips do not reach palm	2
	- paralysis	0

5. Leg, Motor Power

- normal strength 6
- raises straight leg with reduced strength 5
- raises leg with flexion of knee 4
- can move, but not against gravity 2
- paralysis 0

6. Orientation

- correct for time, place & person 6
- two of these 4
- one of these 2
- completely disoriented 0

7. Speech

- no aphasia 10
- limited vocabulary or incoherent speech 6
- more than yes/no, but not longer sentences 3
- only yes/no or less 0

8. Facial Palsy

- none/dubious 2
- present 0

9. Gait

- Walks 5m without aids 12
- walks with aids 9
- walks with help of another person 6
- sits without support 3
- bedridden/wheel chair 0

(Motor power is assessed only on the affected side)

Prognostic score = sum of scores for items, 1, 2, 3 and 5. Maximum prognostic score is 22.

Long term score = sum of scores for items 3, 4, 5, 6, 7, 8 and 9. Maximum long term score is 48.

BARTHEL INDEX[24,25]

1. **Feeding**

   0 = unable

   5 = needs help in cutting, spreading butter etc., or requires modified diet.

   10 = independent

2. **Bathing**

   0 = dependent

   5 = independent (or in shower)

3. **Grooming**

   0 = needs to help with personal care

   5 = independent face / hair / teeth / shaving (implements provided)

4. **Dressing**

   0 = dependent

   5 = needs help but can do about half unaided

   10 = independent (including buttons, zips, laces, etc)

5. **Bowels**

0 = incontinent (or needs to be given enemas)

5 = occasional accident

10 = continent

6. **Bladder**

0 = incontinent, or catheterised and unable to manage alone

5 = occasional accident

10 = continent

7. **Toilet Use**

0 = dependent

5 = needs some help, but can do something alone

10 = independent (on and off, dressing wiping)

8. **Transfers (bed to chair, and back)**

0 = unable, no sitting balance

5 = major help (one or two people, physical) can sit

10 = minor help (verbal or physical)

15 = independent

9. **Mobility (on level surfaces)**

0 = immobile or <50 yards

5 = wheelchair dependent, including corners, >50 yards

10 = walks with help of one person (verbal or physical) >50 yards.

15 = independent (but may use any aid; for example, stick) >50 yards.

10. **Stairs**

O	=	unable
5	=	needs help (verbal, physical, carrying aid)
10	=	independent
Maximum Score	=	100

Stroke was very severe in 19 percent of patients. 62 percent of these patients died in the hospital. In survivors good functional outcome was achieved in 31% and 69% had a poor functional outcome.

Table No. 1 Copenhagen Stroke Study (Results)[21]

S. No	Parameter	Good Outcome %)	Poor Outcome (%)	Unvariate 'P' Value
1.	Living single	35	67	0.008
2.	Home care before stroke	30	33	0.51
3.	DM	19	16	0.76
4.	HT	35	37	0.50
5.	Previous stroke	24	25	0.56
6.	Body Temp (^{O}C)	37.1	37.5	0.15
7.	Blood Glucose (mmol/L)	7.3	8.4	0.09
8.	Initial stroke severity	31	69	P<0.05

G. SCORING SYSTEM[26]

This system uses the following variables to prognosticate in stroke.

i) Complete Limb Paralysis 1

ii) Higher cerebral dysfunction + hemiplegia + hemianopia 1

iii) Drowsy or comatose after 24 hours 1

iv) Loss of consciousness at onset 1

v) Uncomplicated hemi paresis -1

vi) age < 50 - 1

50 - 75 - 2

>75 - 3

R.K. Kumar et al in Amritsar Medical College evaluated this system and published their results. [27]

TABLE No. 2 RESULTS (G Scoring System)

S. No.	Variable	Good Outcome	Poor Outcome
1.	Complete limb paralysis	27%	73%
2.	HCD + Hemiplegia + Hemianopia	25%	75%
3.	Drowsy or comatose at 24 hours	22%	78%
4.	LOC at onset	0	100%
5.	Uncomplicated hemiparesis	92%	8%

A score of 2 or less and 3 predicted 100 and 83.3% chances of good outcome respectively. The probability of poor outcome was 100% when the score was 6.

THE NATIONAL INSTITUTE OF HEALTH STROKE SCALE (NIH SS)[7]

This scale is calculated as given below.

1.a) Level of Consciousness

0 = alert

1 = Not alert, but arousable

2 = not alert requires repeated stimulation to attend.

3 = responds only with reflex motor or autonomic effects or totally unresponsive, flaccid, areflexic

1.b) LOC Questions (ask the month, and his age)

0 = answers both questions correctly

1 = answers one question correctly

2 = answers neither question correctly or is aphasic or stuporous

1.c) LOC Commands

Ask the patient to open and close the eyes and then to grip and release the non paretic hand.

0 = Performs both tasks correctly

1 = performs one task correctly

2 = performs neither task correctly

2. Best Gaze (Test Horizontal eye movements)

0 = normal

1 = partial gaze palsy (Gaze is abnormal in one or both eyes but forced deviation or total gaze paresis are not present).

2 = forced eye deviation or total gaze paresis not overcome by the oculocephalic maneuver.

3. Visual

Visual fields (upper and lower quadrants) are tested by confrontation, using finger counting or visual threat as appropriate.

0 = No visual loss

1 = partial hemianopia

2 = complete hemianopia

3 = bilateral hemianopia (blind including cortical blindness)

4. Facial Palsy

Ask the patient to show teeth or raise eye brows and close eyes.

0 = normal symmetrical movement

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&6 Motor Arm and Leg

The limb is placed in the appropriate position : Extend the arms (palms down) 90 degrees (if sitting) or 45 degrees (if supine) and the leg 30 degrees (always tested supine). Drift is scored, if the arm falls before 10 seconds and the leg before 5 seconds.

0 = no drift

1 = drift, limb holds 90 degrees (or 45), but drifts down before full 10 seconds; does not hit bed or other support.

2 = some effort against gravity the limb cannot get to or maintain the position.

3 = no effect against gravity, limb falls.

4 = no movement

9 = amputation, joint fusion.

5.a Left Arm

5.b Right Arm

0 = no drift

1 = Drift, leg falls by the end of 5 second period but does not hit the 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

9 = amputation, joint fusion.

6.a Left Leg

6.b Right Leg

7. Limb Ataxia

Test with eyes open, intact visual field. Finger - nose - finger test and heel shin tests are performed or both sides, and ataxia is scored only if present out of proportion to weakness. Ataxia is absent in the patient who cannot understand or paralysed.

0 = absent

1 = present in one limb

2 = present in two limbs. If present, ataxia in

Right arm	1= yes	2=No	9=amputation or joint fusion
Left arm	1=yes	2=No	9= amputation or joint fusion
Right leg	1=yes	2=No	9= amputation or joint fusion
Left leg	1=yes	2=No	9= amputation or joint fusion

8. Sensory

Sensation or grimace to pin prick when tested, or withdrawal from noxious stimulus in obtunded or aphasic patients.

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 he/she is being touched.

2 = Severe to total sensory loss patient is not aware of being touched in the face, arm and leg.

9. Best Language

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.

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.

2 = Severe aphasia; all communication is through fragmentary expression; great need for inference.

3 = mute, global aphasia; no usable speech or auditory comprehension.

10. Dysarthria

Ask the patient to read or repeat words from the attached list.

0 = normal

1 = mild to moderate, slurs at least some words and at worst, can be understood with some difficulty

2 = Severe; patients speech is so slurred as to be unintelligible in the absence of or out of proportion to any dysphasia, or is mute/anarthric.

9 = intubated or other physical barrier.

11. Extinction and Inattention (Formerly Neglect)

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 hemi inattention to more than one modality. Does not recognise own hand or orients to only one side of space.

NIHSS AND PROGNOSIS

Several variables identified during the first week after acute stroke were useful in predicting poor outcome including total and motor NIHSS scores, decreased level of consciousness and atrial fibrillation. One study examined the ability of various scales to predict outcome. They found that NIHSSS score >13 had a sensitivity 71% specificity of 90% and a PPV of 82% for predicting a poor outcome define as 'alive in care or dead' at 3 months.[28]

CANADIAN NEUROLOGICAL SCALE

The Canadian Neurological scale (CNS) was designed to assess neurological function in conscious stroke patients. It includes an assessment of level of consciousness, orientation, aphasia and motor strength. It is calculated as follows:

MENTATION

1. Level of Consciousness

i.	alert	3
ii.	drowsy	1.5

2. Orientation

i.	Oriented to place and time	1
ii.	disoriented	0

3. Speech

i.	Normal	1
ii.	Expressive deficit	0.5
iii.	receptive deficit	0

If the patient is able to follow directions and is co-operative section A1 is Chosen, otherwise section A2 is to be followed. If weakness is present, the side which has weakness is evaluated and scored.

Section A1

(No Comprehension Deficit)

(Motor Functions : Weakness)

a) Facial Muscle Weakness	-	i.	None	0.5
		ii.	Present	0

b) Proximal Arm Weakness -	i.	None	1.5
	ii.	Mild	1
	iii.	Significant	0.5
	iv.	Total	0

c) Distal arm - scoring is same as that for Proximal arm

d) Proximal leg - scoring is same as that for Proximal arm

e) Distal leg - scoring is same as that for Proximal arm

Section A2 - Comprehension Deficit

(with receptive speech deficit)

a) Face symmetrical	0.5
asymmetrical	0
b) Muscle Strength Arms Equal	1.5
Unequal	0
c) Muscle Strength Legs Equal	1.5
Unequal	0

This score ranges from 0 to 11.5

The Canadian Neurological Scale study correlated with outcome. Stroke patients older than 70 years with CNS score <4.5 at onset had a 90% chance of death or disability at 4 months.

These scoring systems were developed to prognosticate the long term outcome of stroke patients including death and disability. Very few scoring

systems are available for predicting early mortality. Bhalla and others have attempted using APACHE III scoring system. Bandolier used 5 simple clinical parameters. Rodrigues and Joshi developed a scoring system in India, which was used in this study.

APACHE - III (Score)

The acute physiology, age, chronic health evaluation III score (APACHE - III) includes scoring for various parameters reflecting age, chronic health status, physiological status, acid base status and the neurological status. The 'physiological score' includes pulse, mean blood pressure, temperature, respiratory rate, oxygen saturation, hematocrit, WBC count, serum creatinine, urine output, BUN, serum sodium, albumin, bilirubin and glucose. The neurological score is calculated based on the motor response to painful or verbal stimuli. The maximum APACHE III score is 299 and the minimum is 0.

The APACHE - III Scoring system was designed to evaluate the mortality rate of critically ill patients. As shown earlier, it includes various physiological parameters and vital signs. Rodrigues and Joshi's scoring system gives more importance to age, seizures and aspiration pneumonia. Bandolier has included admission blood glucose levels and body temperature. It is evident that these later scoring systems could be used to predict mortality rather than the former ones (NIHSS, SSS, CNS) which use only the neurological parameters.

Analysis of early deaths after stroke is important, since some deaths may be preventable. In a prospective study comprising 1073 consecutive stroke

patients admitted to an intensive care stroke unit from a well defined population, there were 212 deaths within first 30 days yielding a mortality rate of 20%.[31] Early mortality after stroke exhibits a bimodal distribution. One peak occurs during the first week, and a second during the second and third weeks. The majority of deaths in the first week are due to transtentorial herniation. The deaths due to hemorrhage usually occur within first three days whilst deaths due to infarction peak between the third and sixth day of stroke onset. After the first week, deaths due to relative to immobility (Pneumonia, Pulmonary embolism and sepsis) predominate, peaking towards the end of the second week. Cardiac deaths occur through out the first month and unfortunately account for many deaths in patients, with small functional deficits. Other complications include seizures, arrhythmias, myocardial infarction, DVT, electrolyte disturbances, pressure sores, urinary tract infections. Frozen shoulder, contractions are long terms complications. 25% patients develop depression after stroke which must be appropriately treated.[31]

The following are the causes for deterioration of the clinical status of a patient suffering from stroke.[20]

Neurological

- Progression or completion of stroke
- extension or early recurrence
- hemorrhagic transformation of an infarct
- developing cerebral edema
- obstructive hydrocephalus
- epileptic seizures

Non Neurological

- infections
- metabolic derangements
- drugs
- hypoxia
- hypercapnia

These above factors contribute significantly to early mortality in stroke. According to the Early/Progressing stroke study (EPSS)[32] group attached to Queen Elizabeth, Hospital, Gateshead, UK early neurological deterioration was shown to be common, occurring in nearly 1/3 patients in first 3 days after acute stroke especially in patients with primary intracerebral hemorrhage. Use of antiplatelet drugs and atrial fibrillation were independent risk factors for early deterioration.

Toni et al report that a fifth of (22.41%) patients with acute ischemic supratentional stroke had neurological improvement within 30 days. 3% of patients with improving acute ischemic stroke was dead at 30 days. A sixth and a third of stable and deteriorating acute ischemic stroke patients respectively were dead at 30 days.[33]

Bhalla A and the Guptas studied a series of seventy four patients in Wardha, India. 30 patients had intracerebral hemorrhage (40.5%) and 44 had infarction (59.5%). Seventeen patients out of 30 in the hemorrhagic group (56.6%) and 10 out of 44 (22.7) in the infraction group died. The overall mortality observed was 34% (27/74 patients). They also used the APACHE III

scoring system as a method of prediction of mortality in stroke patients. The score had a sensitivity and specificity of 94.12% and 52.85% respectively in predicting mortality in patients with hemorrhage, 90% and 73.53% respectively for ischemic stroke when a cut off point of 40 was taken[29].

In an Australian stroke Unit, the case fatality is about 25% during the first 30 days after a stroke and the major cause of death is the index stroke and its sequelae. The most consistent predictor of 30 day mortality after stroke is stroke severity. Other predictors include increasing age, a history of previous stroke, cardiac failure and a high blood glucose concentration and WBC count.[34]

According to the German stroke registers study group (ADSR) the inhospital mortality was 4.9% among a total of 13440 ischemic stroke patients. In women, higher age ($P<0.001$), severity of stroke ($P<0.001$) and atrial fibrillation (HR 1.3; 95% CI 1.0-16) were independent predictors for inhospital death. In men, diabetes (HR 1.4; 95% CI 1.0-1.9) had a significant negative impact on early outcome in addition to factors identified for women. Pneumonia was the complication with the highest attributable proportion of deaths in entire stroke population accounting for 31.2%.[35]

MATERIALS AND METHODS

SETTING : Medical wards of Government General Hospital, Chennai

STUDY : Single centre observational, prospective and hospital based study

PERIOD OF STUDY : June 2005 - Sep 2006

Government General Hospital is a tertiary care and referral center for patients from all over south India. All stroke patients admitted within the above period and who satisfied set criteria were included.

INCLUSION AND EXCLUSION CRITERIA

1. Stroke patients as defined by WHO criteria were included in the study. It is defined as rapidly developing clinical signs of focal or global neurological deficit with no apparent cause other than vascular origin.

2. All patients who presented within 24 hours of onset of stroke and who gave informed consent to participate in the study were included.

3. Patients with subarachnoid hemorrhage or other structural or metabolic or traumatic causes for the clinical features were excluded. Patients with serious infections or other systemic diseases (apart from the parameters considered) which could alter the clinical course eg. rheumatic heart disease were excluded.

4. Elaborate history was taken from all patients or from their attenders. Special emphasis was given to their age, presence of hypertension diabetes and history of previous stroke. History of smoking and prior coronary artery disease was sought.

   A complete physical examination and a detailed neurological examination were done.

   ECG was recorded for all patients. A basic cardiac evaluation including an echocardiogram was done for all patients.

   Routine biochemical investigations including serum electrolytes were done. These investigations were repeated periodically or when the patient detiorated.

5. Patients with features of posterior circulation stroke were excluded.

6. All patients were subjected to computed tomography (CT) investigation of brain.

No patient with atherothrombotic infarct in this study received thrombolytic therapy. No patient with intracerebral hemorrhage underwent evacuation of the hematoma. Anticoagulants like Heparin either LMWH or unfractionised Heparin were not administered to any of the patients in the study group.

All patients were managed with general supportive care. Anti edema measures were given when needed. Patients were intubated and mechanical ventilation was given when their oxygen saturation fell. Vitals were monitored periodically. All the patients were followed up for a period of seven days or till death whichever was earlier.

ENDPOINT

The primary end point was the outcome of the patient after 7 days of onset of stroke either death or survival.

The following factors were considered and analyzed as predictors of mortality

1. Age
2. Sex
3. Diabetes Mellitus

Patients with known diabetes before stroke and those who were diagnosed during the hospital stay were included in the diabetic group.

4. Hypertension

Patients with known hypertension before stroke or patients requiring anti hypertensives to maintain BP < 140/90 five days after stroke onset were included in the hypertensive group.

5. Grading of mental obtundation at onset.

Grade	0	-	Patients alert and well oriented
Grade	1	-	Drowsy but arousable
Grade	2	-	responding to deep, painful stimuli only
Grade	3	-	deeply comatose, not responding to deep painful Stimuli.

6. Previous stroke.
7. Stroke subtype - Hemorrhage or infarct on CT scan.

8. Persistent altered consciousness after 48 hours.
9. Altered consciousness appearing in first 24 to 72 hours.
10. Presence of complete hemiplegia.
11. Seizures during hospital stay.
12. Aspiration pneumonitis.
13. Body temperature

    Oral temperature was recorded on admission. It is usually 0.5°C less than core temperature.

14. Blood glucose in first 24 hours after stroke onset
15. Presence of dysphagia
16. Presence of urinary incontinence.

All patients were also submitted to scoring by using

1 Rodrigues and Joshi's score

2 Bandolier prognostic index.

3 CT Scoring

Bandolier Prognostic index

	Parameter	Point
i)	impaired consciousness	5
ii)	Urinary incontinence	4
iii)	dysphagia	3
iv)	admission temp. (≥ 100°F)	2
v)	hyperglycemia (≥126 mg/l) with no history of diabetes	2

Total Score = Sum (i) to (v). A score above 11 was taken as a predictor of mortality.

CT Scoring

CT features	Finding	Points
(1) Massive and / or multiple lesions	Yes	+30
(Involving > 1/3 of area supplied by the artery	No	0
(2) Gross mass effect	Yes	+22
	No	0
(3) Constant		+3

Total score = 1+2+3

A score more than 33 was taken as a predictor of mortality.

Rodrigues and Joshi's System

S. No	Clinical parameter	Finding	Points
1.	Age	(in years)	0.4 x (age)
2.	History of previous stroke	Yes No	+18 0
3.	Mental obtundation at onset	Grade 0 Grade 1 Grade 2 or 3	0 +8 See below
4.	Persistent altered consciousness (Beyond first 48 hours)	Yes No	+40 0
5.	Altered consciousness Appearing in first 24-72 hours	Yes No	+23 0
6	Complete hemiplegia	Yes No	+6 0
7.	Seizures during hospital stay	Yes No	+15 0
8.	Aspiration pneumonia	Yes No	+32 0
9.	Constant		-21

Total sum 1 to 9

A score of 63 and above was taken as a predictor of mortality.

STATISTICAL METHODS

Statistical analysis was done using chi-square test for non continuous data.

Degrees of freedom = (R - 1) x (C - 1)

$$\text{Chi – Square } (X^2) = \Sigma \frac{(O-E)^2}{E}$$

O→ Observed outcome

E→ Expected outcome

The chi-square chart was consulted to get 'p' value. The required 2-tailed significance level for all tests was set at 0.05.

Statistical analysis was done using students 't' test for continuous data. The required 2 - tailed significance level for all tests was set at 0.05. All these analyses were done using the SPSS software.

TABLES/CHARTS (RESULTS)

Table - 3: Sex Distribution

Sex	Frequency	%
Male	82	51.25
Female	78	48.75
Total	**160**	**100**

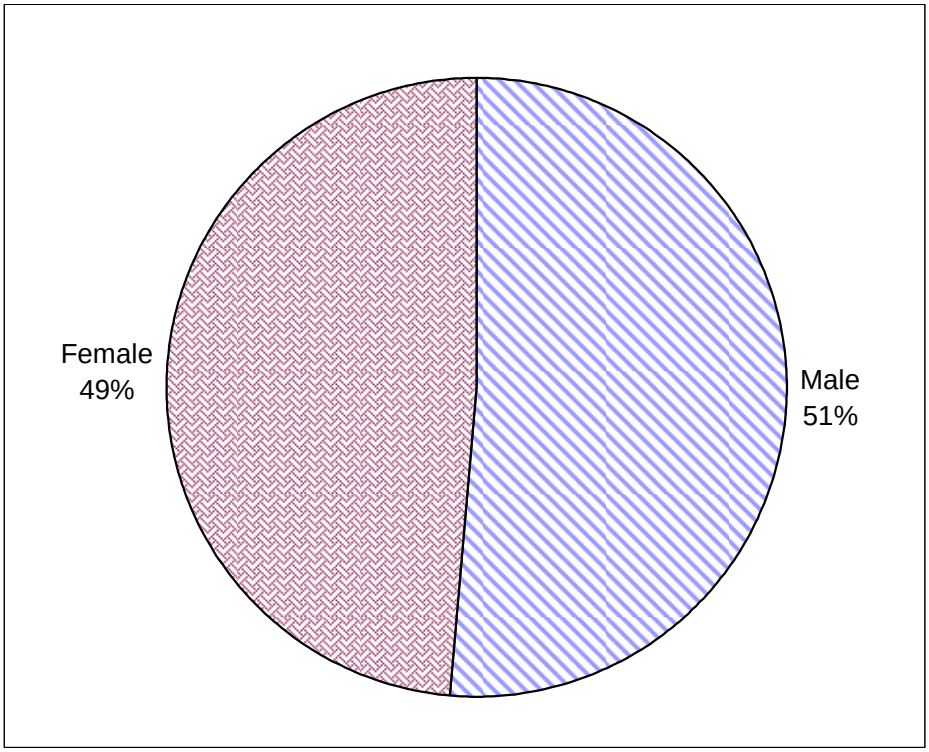

Figure - 3: Sex Distribution

Table - 4: Age Distribution

Age Group	Frequency	%
≤ 40	30	18.75
41-59	65	40.63
≥ 60	65	40.63
Total	**160**	**100**

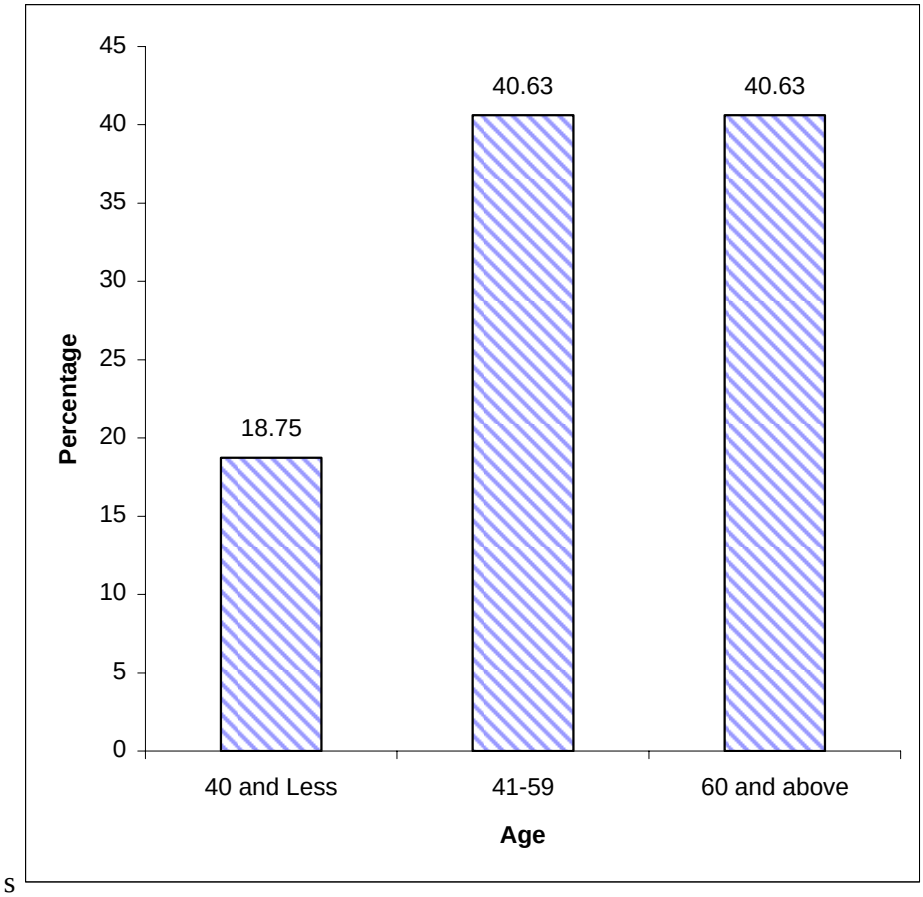

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Figure - 4: Age Distribution

Table - 5 Stroke Subtype and Outcome

	Survived	Death	Total	P value
Infarct	117 (88%)	16 (12%)	133 (83%)	< 0.01
Hemorrhage	14 (51.9%)	13 (48.1%)	27 (16.9%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

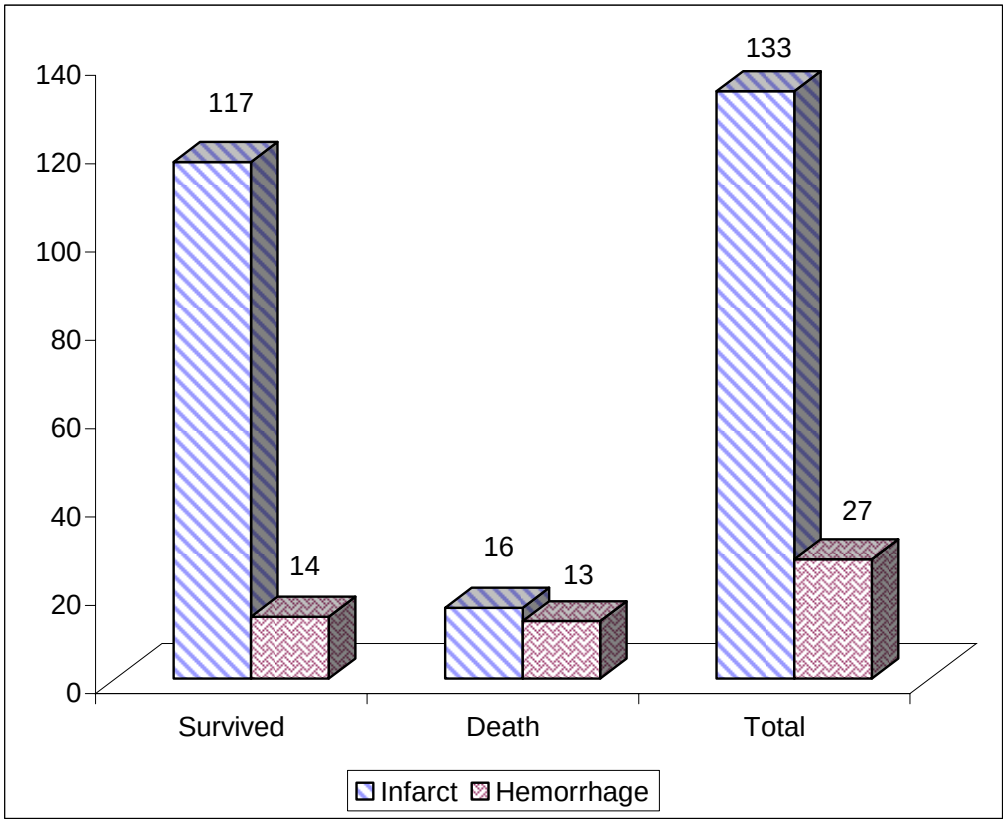

Figure - 5: Stroke subtype and Outcome

Table - 6: Sex and Outcome

	Survived	Death	Total	P value
Men	67 (81.7%)	15 (18.3%)	82 (51.3%)	P = 0.95
Women	64 (82.1%)	14 (17.9%)	78 (48.8%)	
Total	**131 (81.4%)**	**29 (17.9%)**	**160 (100%)**	

Table - 7: Age and Outcome

	Survived	Death	Total	P value
≤ 40	29 (96.7%)	1 (3.3%)	30 (18.8%)	P = 0.013
41 - 59	55 (84.6%)	10 (15.4%)	65 (40.6%)	
≥ 60	47 (72.3%)	18 (27.7%)	65 (40.6%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Table - 8: Diabetes and Outcome

	Survived	Death	Total	P value
Yes	45 (69.2%)	20 (30.8%)	65 (40.6%)	p < 0.01
No	86 (90.5%)	9 (9.5%)	95 (59.4%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Table - 9: Hypertension and Outcome

HT / Outcome	Survived	Death	Total	P value
Yes	62 (70.5%)	26 (29.5%)	88 (55.0%)	p < 0.01
No	69 (95.8%)	3 (4.2%)	72 (45.0%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Table - 10: Previous Stroke and Outcome

	Survived	Death	Total	P value
Yes	16 (48.5%)	17 (51.5%)	33 (20.6%)	p < 0.01
No	115 (90.6%)	12 (9.4%)	127 (79.4%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Table - 11: Mental Obtundation and Outcome

	Survived	Death	Total	P value
Grade 0	88 (100%)	0	88 (55%)	P < 0.01
Grade 1	40 (76.9%)	12 (23.1%)	52 (32.5%)	
Grade 2	3 (21.4%)	11 (78.6%)	14 (8.8%)	
Grade 3	0	6 (100%)	6 (3.8%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

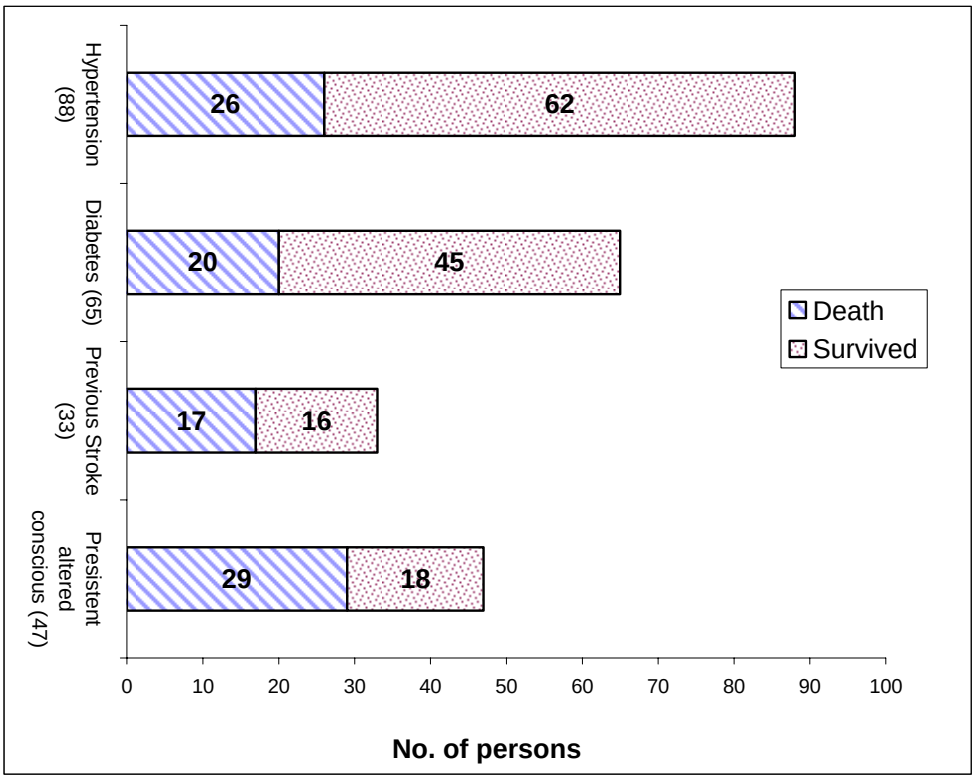

Figure - 6: Various Parameters and Outcome

Table - 12: Persistent Altered Consciousness and Outcome

	Survived	**Death**	**Total**	**P value**
Yes	18 (38.3%)	29 (61.7%)	47 (29.4%)	P < 0.01
No	113 (100%)	0	113 (70.6%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Table - 13: Altered Consciousness appearing after 24 Hours

	Survived	**Death**	**Total**	**P value**
Yes	2 (100%)	0	2 (1.3%)	P = 0.50
No	129 (81.6%)	29 (18.4%)	158 (98.8%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Table - 14: Complete Hemiplegia and Outcome

	Survived	Death	Total	P value
Yes	63 (68.5%)	29 (31.5%)	92 (57.5%)	P < 0.01
No	68 (100%)	0	68 (42.5%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Table - 15: Seizures and Death

	Survived	Death	Total	P value
Yes	6 (26.1%)	17 (73.9%)	23 (14.4%)	p < 0.01
No	125 (91.2%)	12 (8.8%)	137 (85.6%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Table - 16: Aspiration and Death

	Survived	Death	Total	P value
Yes	4 (12.5%)	28 (87.5%)	32 (20%)	P < 0.01
No	127 (99.2%)	1 (0.8%)	128 (80%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Table - 17: Dysphagia and Death

	Survived	Death	Total	P value
Yes	39 (59.1%)	27 (40.9%)	66 (41.3%)	P < 0.01
No	92 (97.9%)	2 (2.1%)	94 (58.8%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Table - 18: Urinary Incontinence and Death

	Survived	Death	Total	P value
Yes	35 (54.7%)	29 (45.3%)	64 (40%)	P < 0.01
No	96 (100%)	0	96 (60%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

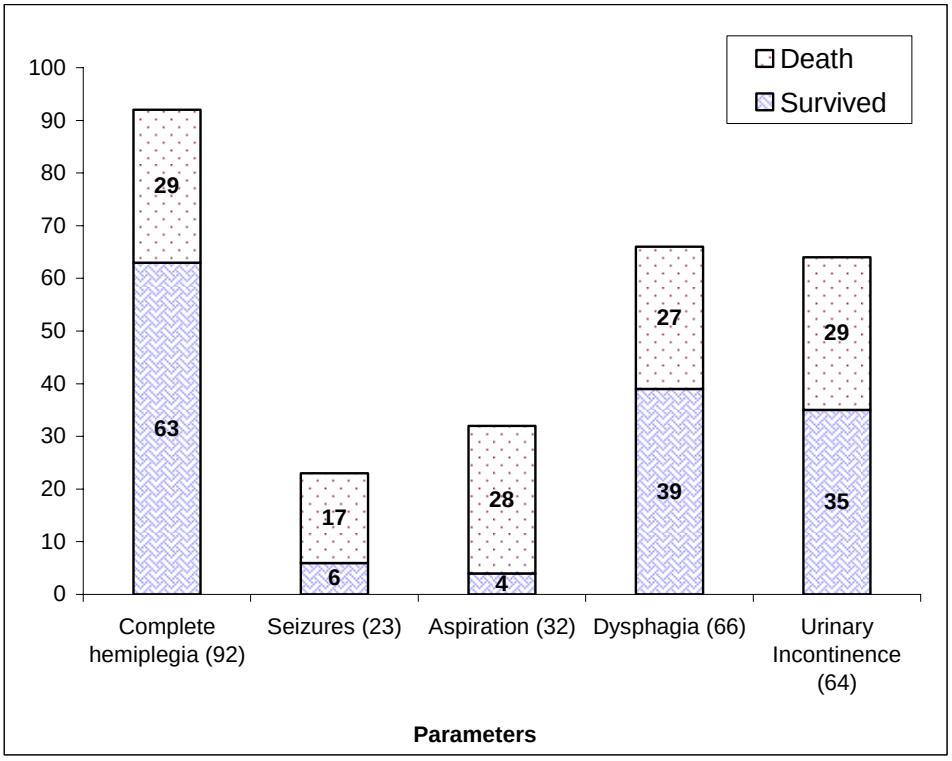

Figure - 7: Various parameters and Outcome

Table - 19: High Blood Sugar Levels and Death

mg/dL	Survived	Death	Total	P value
<126	103 (94.5%)	6 (5.5%)	109 (68.1%)	P < 0.05
≥ 126	28 (54.9%)	23 (45.1%)	51 (31.9%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Table - 20: High Temperature on Admission and Death

°C	Survived	Death	Total	P value
< 100	108 (96.4%)	4 (3.6%)	112 (70%)	P < 0.05
≥ 100	23 (47.9%)	25 (52.1%)	48 (30%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Table - 21: Rodrigues and Joshi Score

	Survived	Death	Total	% P value
Score ≥ 63	8 (21.6%)	29 78.4%)	37 (23.1%)	p < 0.01
< 63	123 (100%)	0	123 (76.9%)	
Total	**131 (81.9%)**	**29 (18.1%)**	**160 (100%)**	

Sensitivity - 100%

Specificity - 93.9%

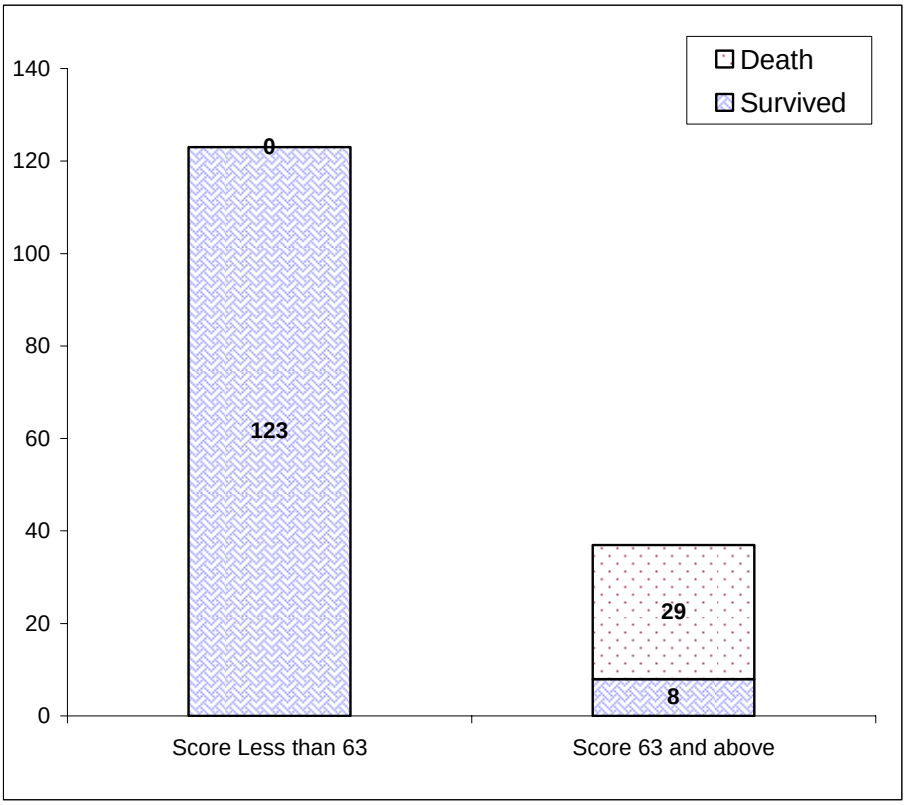

Figure - 8: Rodrigues and Joshi score and death

Table - 22: CT Scoring

	Death	Survived	Total	% P value
Score > 33	19 (86.4%)	3 (13.6%)	22 (13.8%)	p < 0.01
≤ 33	10 (7.2%)	128 (92.8%)	138 (86.3%)	
Total	**29 (18.1%)**	**131 (81.9%)**	**160 (100%)**	

Sensitivity - 65.5%

Specificity - 97.7%

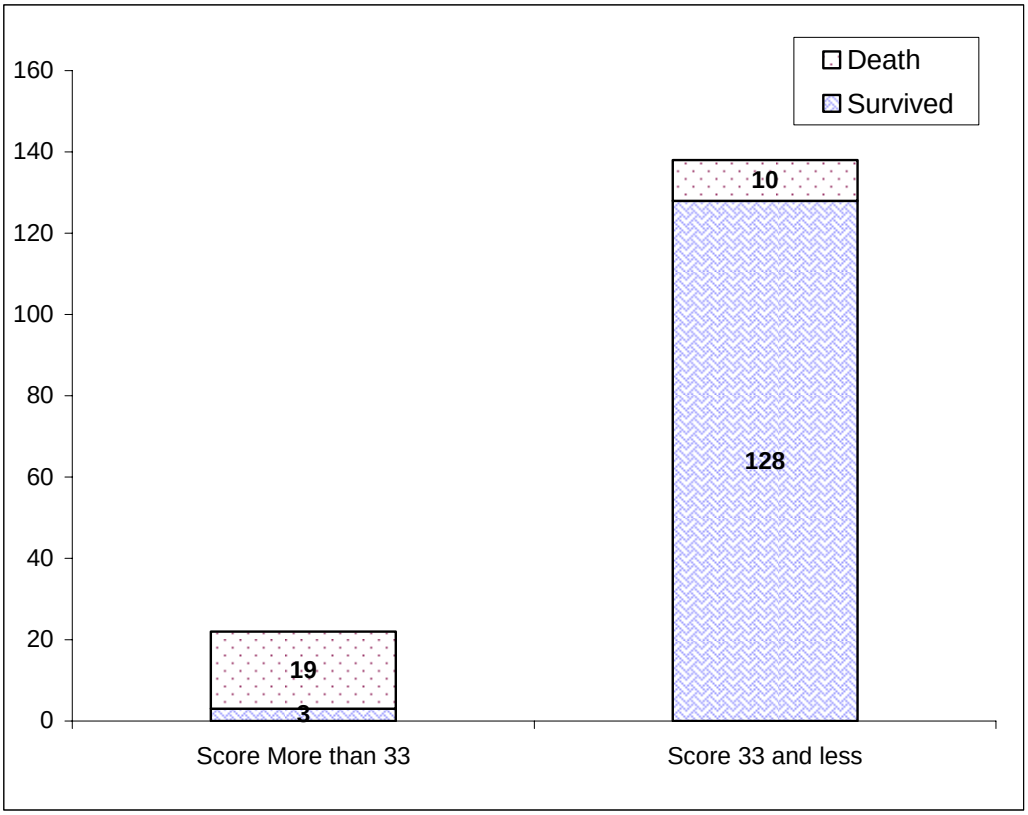

Figure - 9: CT Scoring and Death

Table - 23: Bandolier Prognostic Index

	Death	Survived	Total	P value
Score > 11	28 (57.1%)	21 (42.9%)	49 (30.6%)	P < 0.01
≤ 11	1 (0.9%)	110 (99.1%)	111 (69.4%)	
Total	**29 (18.1%)**	**131 (81.9%)**	**160 (100%)**	

Sensitivity - 96.6%

Specificity - 84%

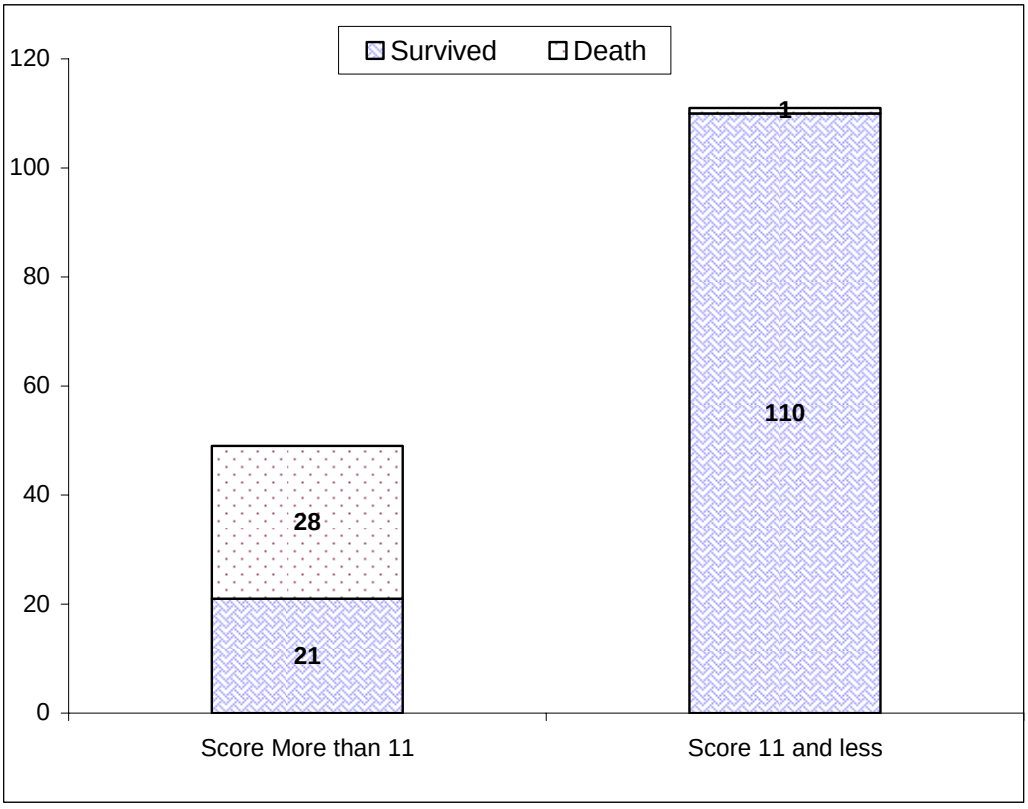

Figure - 10: Bandolier Prognostic Index and Death

RESULTS AND OBSERVATIONS

A total of 160 patients admitted with diagnosis of anterior circulation stroke during the study period were included in the study. Of these 82 (51.25%) were men and 78 (48.75%) were women. Among these 133 (83.13%) suffered infarction and 27 (16.88%) had intracerebral hemorrhage. Their ages ranged from 30 to 86. The mean age was 54.65.

Stroke Subtype and Death

Thirteen persons out of 27 in the hemorrhagic group (48.1%) and sixteen out of 133 in the infarct group (12.0%) died. The over all mortality observed was 18.1% in all the patients (29/160 patients). This showed significant association between hemorrhage and death ($P < 0.01$)

Age and Death

Only one out of 29 in the below 40 age group (3.3%) and 18 out of 65 (27.7%) in the 60 and above age group died. There was a significant increase in mortality ($P = 0.013$) with increasing age.

Sex and death

Fifteen out of 82 men (18.3%) and 14 out of 78 women (17.9%) died. There was no significant correlation ($P = 0.95$) observed between sex and the outcome.

Diabetes and Death

Sixty five patients (i.e. 40.6%) of the total had diabetes mellitus. Of these 65 persons, 20 (30.8%) died. Among the rest who were non-diabetics 9 deaths were observed. Presence of diabetes was associated with a higher mortality which was statistically significant ($P < 0.01$).

Hypertension and death

Eighty eight out of the 160 (55%) had hypertension as one of the risk factors for stroke. Twenty six (29.5%) of them died. The number of deaths among non hypertensives was a mere three. Thus a very significant association ($P < 0.01$) was observed between hypertension and death.

Moreover hypertension was significantly associated with both ischemic ($P < 0.05$) and hemorrhagic ($P < 0.001$) strokes. Three patients had non valvular atrial fibrillation, none of them died during the period of study.

Previous stroke and death

Thirty three patients (20.6%) had a history of previous stroke prior to the present admission. Of these seventeen (51.5%) died, demonstrating a significant increase in death rate ($P < 0.01$) in those with recurrent strokes.

Level of consciousness on admission and death

The level of consciousness on admission was clearly associated with outcome in this study. 88 patients were fully alert (i.e. mental obtundation Grade 0) and none of them died. Six were comatose (Grade 3) and all of them died. 78.6% of those who hade Grade 2 mental obtundation (11 out of 14) died.

52 patients had Grade 1 mental obtundation and 12 (23.1%) of them died. There was significant correlation between altered consciousness and death ($P < 0.01$).

Persistent altered consciousness and death

Forty seven patients (29.4%) had persistent altered consciousness beyond 24 hours of onset of stroke, of whom 29 (61.7%) died, revealing a significant statistical correlation ($P < 0.01$).

Appearance of new altered consciousness after 24 hrs

Two patients who were fully alert on admission slipped into altered conscious state and they were alive on seventh day of onset of stroke. No significant association was found, ($P = 0.50$) perhaps the numbers in this sub group is small.

Complete hemiplegia and death

Ninety two patients among those in the study i.e. 57.5% had complete hemiplegia (Grade 0 power) on admission and 29 (31.5%) of them died. Sixty eight patients were admitted with hemiparesis and all of them survived till seventh day. There was thus a significant association between early death and severity of stroke ($P < 0.01$).

Seizures and death

Twenty three patients (14.4%) developed seizures at one time or another during their period of hospital stay and 17 (73.9%) of them died, ($P < 0.01$) demonstrating a significant association.

Aspiration and death

Aspiration was observed to be a common mode of death among many patients. Thirty two (20%) patients developed aspiration and 28 (87.5%) of them died proving a very significant association with mortality ($P < 0.01$).

Dysphagia and death

Sixty six patients (41.3%) had dysphagia during their hospital stay and 27 of them (40.9%) died. Two patients without difficulty in swallowing succumbed to the disease. There was thus a significant association between dysphagia and death ($P < 0.01$).

Urinary incontinence and death

Sixty four patients had urinary incontinence and 29 of them (45.3%) died. There was a significant association observed between incontinence and death ($P < 0.01$).

Initial Body temperature and Blood glucose level on admission

The mean body temperature of all patients was 99.58°F and their mean glucose level was 119.02 mg/dL. Forty eight patients had a temperature of 100°F and more and 25 of them died. Fifty one patients had blood sugar level of 126 mg/ dL and more on admission and 23 of them died. There was a significant association between high body temperature and high blood glucose levels or admission and death (P value in both situations was < 0.05).

Rodrigues and Joshi - Scoring

Rodrigues and Joshi's scoring system was used to assess all these stroke patients who were studied. The clinical scores were affected by the age of patients. The maximum clinical score may be > 150 and minimum - 9. The maximum score observed was 124 and minimum score was - 9.

A total of 123 patients had a Joshi's score less than 63 and all of them survived. Thirty seven had a score 63 and above, 29 of them (78.4) died. Using 46 as a limit there was a 40-60 chance of survival and death. When the score of 63 and above was used as a cut off value to prognosticate death, this scoring system was 100% sensitive and 93.9% specific.

Bandoliers prognostic index

An arbitrary score of less than and more than 11 was being used to prognosticate mortality using this index. In this study 111 patients had a score of 11 and below, one of them died (less than 1%). Twenty eight of the 49 patients who had a score greater than 11 (57%) died.

Sensitivity of this score is thus 96.6% and specificity is 84%.

CT - scoring system (by Rodrigues & Joshi)

A CT score of 33 and below was used to predict a good outcome and a score above 33, a bad one. In this study 138 patients (86.3%) had a score of 33 and less, of whom 10 (7.2%) died. Nineteen out of 22 who had a score greater than 33 (86.4%) died.

Sensitivity of this score was thus 65.5% in predicting mortality. The specificity was 97.7%.

All these three scoring systems were found to be statically significant by choosing the above ($P < 0.01$) cut off points in predicting mortality. The correlation co-efficients for Joshi's score, Bandolier prognostic index and the CT score are 0.85, 0.66, 0.68 respectively.

DISCUSSION

Acute stroke is a heterogeneous condition with respect to prognosis. At present it is very difficult to predict outcome in an individual with great accuracy.[3] In acute stroke the chances of survival depend on various factors like neurological damage, systems dysfunction and social factors.[36] Brenn and Sheikh observed that the factors associated with adverse outcome in stroke included male sex, unconsciousness, Glasgow coma scale of 3, gaze palsy, pupillary changes and incontinence.[37] The risk of death in first few days is best gauged by three clinical variables, i.e. coma, paresis and incontinence, the indicators of severity of neurological dysfunction, along with cardiac variables like heart failure, atrial fibrillation and peripheral vascular disease.[37] Though the stroke related mortality is steadily declining in the west, it has been rising in India. This is due to the fact that the life expectancy has increased and urbanization has changed the life style.

STROKE MORTALITY

The total mortality observed at the end of first week in this study was 18%. In the west where acute stroke care centres are fully equipped the rate is as low as 5%.[38,39] Bhalla A. et al observed a mortality of 34% at Sevagram, Wardha.[29]

In this study patients with hemorrhage had a higher mortality rate of 48% (13 out of 27 died) whereas among those with infarcts it was 12% (16 out

of 133 died). Infarcts accounted for 83% of strokes and hemorrhage constituted the remaining 17%.

The early mortality in stroke is reported to be around 20% in white population.[5] Kazi et al reported an overall mortality due to all causes as 20% in all stroke patients.[40] The Canadian Institute of health reports 30 day mortality of 18.8%.[41]. Tzong et al from Singapore found the mortality at the end of first month to be 20.3%.[42] The all cause stroke mortality observed by Bhalla A et al was 34% an Indian study. Their study was compared with this study.

Table No.24 Comparative Statistics with Bhalla's study

Sl. No.	Particulars	Bhalla et al [29] (%)	Current Study (%)
	Conducted at	Sevagram, Wardha	Chennai
1.	No. of subjects	74	160
2.	No. of patients with Hemorrhage	30 (40.5)	27 (16.9)
3.	Deaths in h'agic group	17 (56.6)	13 (48.1)
4.	No. of patients with infarct	44 (59.5)	133 (83.1)
5.	Deaths in infarct group	10 (22.7)	16 (12.0)
6.	Over all Mortality	27 (34)	29 (18.1)
7.	Prognostication score	APACHE III	i. Rodrigues & Joshi Score ii. Bandolier index
8.	Sensitivity	90%	i. 100% ii. 96.6%
9.	Specificity	73%	i. 93.9% ii. 84%

(In the current study, number of deaths include only those that occurred within 1 week of onset of stroke).

This study included patients with anterior circulation stroke only. It is a well known fact that the mortality rate is higher among the patients with posterior circulation stroke. Perhaps that is why the mortality rate in our study is lower than that observed (18 vs 34%) by Bhalle et al, an another Indian study. Also, an arbitrary period of 1 week was chosen to predict early mortality in this study whereas it was not so in the other study. Improved medical care including fully equipped stroke care units, prompt detection and complete treatment of risk factors like hypertension, diabetes and declining incidence of smoking[43] may be the reasons for reduced mortality rates observed in the west.

STROKE GRADING

NIHSS, the widely used scale to grade the severity of stroke, predicted 75% of patients with a score > 17 at base line, had a poor outcome. NIHSS correlated well with lesion volume also.[28]

Likewise, the Canadian neurological scale predicted a poor outcome at 4 months for 90% when the score was less than 4.5.[28] G scoring system predicted the outcome with a sensitivity of 83.3%.[27] Munir et al have compared this scoring system with the NIHSS. The results are shown in the table 25. All these systems were in general prognostic scores evaluating the long term prognosis in stroke patients. So, these scoring systems could not be used exclusively to predict inhospital early mortality. Moreover, these scoring systems relied heavily on the neurological factors alone.

Table No. 25: Comparison statistics of different stroke scales

S. No.	Particulars	NIHSS (Munir et al)	G - Score (Munir et al)	Current Study	
				Rodrigues Joshi	Bandolier Index
1	Year	1995	1995	2006	2006
1.	No. of subjects	379	379	160	160
2.	Mean age	69	69	55	55
3.	% men	51	51	51	51
4.	% infarct	88	88	83	83
5.	% hemorrhage	12	12	17	17
6.	Deaths	76	76	29	29
7.	% Deaths	20	20	18	18
8.	Mean Score for Dead	18	-8.5	103	14
9.	Sensitivity (%)	71	70	100	96.6
10.	Specificity (%)	90	89	93.9	84
11.	Positive Predictive Value (%)	82	80	78.4	57.1

Rodrigues and Joshi studied 120 consecutive patients at BYL Nair hospital in Mumbai, India (period of study: August 1986 to January 1987) and predicted a prognostic score for immediate outcome based on early clinical findings.[9] In their study, patients with clinical scores ≤ 46 had a 50% or better chance of survival, while patients with scores ≥ 47 had a 50% or greater chance of death. A clinical score ≤ 12 was associated with 99% chance of survival and 99% chance of death when the score was ≥ 63.

Using this cut off of 63, the scoring system was found to be 100% sensitive and 93.9% specific by this study.

CT scoring was not statistically significant in predicting mortality according to Rodrigues and Joshi study. This study found that a score greater than 33 was specific. This scoring system does not consider the location of the lesion or the accurate size of the lesion. It merely considers whether there were massive or multiple lesions and mass effect. Among our patients CT was taken on the day of admission irrespective of time of onset of stroke. Follow - up or subsequent CT scans were taken only when specifically indicated and patients relatives were willing due to cost of the test.

Table No.26 Comparative Statistics[9,10]

Parameter	Original Study	This Study
1. Rodrigues & Joshi Scoring		
a. No. of subjects	120	160
b. Year	1986	2006
c. Survival when score < 46	50%	40%
d. Death when score > 63	99%	100%
2. CT scoring CT > 33 Score	Not Significant	Significantly Predicts death (P < 0.05)
3. Bandolier Prognostic index		
a. No. of subjects	440	160
b. Year	2000	2006
c. Mortality when score is > 11	75%	57%
d. Mortality when score is < 11	3%	1%

CT though not as sensitive as MRI in detecting early infarcts was used because MRI is far more expensive them CT. Even though this study found significant results with CT score, a more descriptive scoring, measuring the volume of clot or hemorrhage, location of the lesion etc. with due consideration to time duration lapsed since onset of stroke is suggested for better results.

Bandolier prognostic index uses temperature and initial blood sugar levels apart from neurological parameters which were not considered in the Joshi's score. According to this index a score < 11 predicted 3% mortality whereas it was 75% when the score was more than 11.[10] Using this cut off score the mortality in this study was less than 1% and 57% respectively.

Comparing the two scoring systems both were sensitive and Joshi's scoring system was more specific than Bandoliers index. Both these scoring systems do not consider the subtype of stroke i.e. whether it was an infarct or hemorrhage. In this study a correlation between hemorrhage and death was found. Moreover none of the patients in this study group underwent evacuation of hematoma as a mode of treatment.

Bhalla A, Gupta OP, and Gupta SB studied 74 patients admitted at the Mahatma Gandhi Institute of Medical Sciences, Sevagram. Those patients were admitted to the medical ICU there. They used APACHE III scoring system to predict mortality. The sensitivity and specificity of the scoring system was 94.12% and 53.85% respectively, in patients with hemorrhage, 90% and 73.53% respectively for ischemic stroke when a cut off point of 40 was taken. They also observed that the likelihood of mortality increased as the score increased.

The advantages of APACHE III scoring system as shown in the above study should be considered only after understanding the fact that the study was conducted at the ICU of the institute where perhaps only critically ill patients having CVA were admitted. Yet a scoring system which includes various parameters like physiological variables, vitals, urine output, neurological score along with age related parameters and comorbid conditions must be an effective predictor of short term outcome in CVA patients.

OTHER PREDICTORS OF MORTALITY

The important risk factors like diabetes, hypertension or smoking contribute to stroke. Atrial fibrillation (non valvular) was found to be an independent risk factor for mortality in a study conducted by Peter Apprelros and others.[44] They found the 1 year mortality after stroke to be 33% in the study which comprised of 377 patients.[44] Abnormal cardiac rhythm, an important factor in cardioembolic stroke is not considered while computing the scoring system. In this study strokes in patients with rheumatic heart disease were not included. Three patients had non valvular atrial fibrillation and none of them died. Hypertension and diabetes were clearly independent risk factors for early mortality in this study.

The immediate prognosis for large and medium sized cerebral clots and even smaller ones in cerebellum / brainstem is grave.[36] Either hemorrhage extends into ventricular system or intracranial pressure is elevated to levels that preclude normal perfusion. Sometimes the hemorrhage itself seeps into vital centers such as hypothalamus or midbrain. In patients who survive - i.e. those with smaller hemorrhages - there can be surprising degree of restoration of function, since in contrast to infarction the hemorrhage has to some extent pushed brain tissue aside rather than destroyed it.[36] In this study 13 out of 27 patients with hemorrhage died ($P < 0.05$).

Haroun M[45] and others from Ain Shans University in Egypt studied early mortality predictors of death among 526 stroke patients. They found significant association between the following parameters and death: 1. increasing age 2. altered conscious level on admission, 3. presence of Bulbar

symptoms 4. previous heart disease, 5. previous history of stroke 6. high blood pressure and 7. increased body temperature. All associations were statistically highly significant (P< 0.01).

Table - 26: Comparative Statistics

Parameters	Haroun M et al.,[45]	Current Study
Place of Study	Ain Shaun University Egypt	GGH, Chennai
1. No. of participants	526	160
2. No. Deaths (%)	58 (11%)	29 (18.1)
3. Mean age of Survivors	54.6	52.68
4. Mean age of deceased	71.0	64.0
5. Altered Conscious level Survived, Death, P value	70, 46, < 0.01	43, 29, < 0.01
6. Bulbar Symptoms (S,D,P)	85, 35, < 0.01	NA
7. Previous Stroke (S, D, P)	50, 21, < 0.01	16, 17, < 0.01
8. Increased Body temperature (S, D, P)	60, 41, < 0.01	23, 25, < 0.01
9. High BP (S, D, P)	212, 50, < 0.01	62, 20, < 0.01
10. High Blood Glucose (S, D, P)	NA	28, 20, < 0.01

(S,D,P) = Survived, Dead, P value)

Both diabetic patients and patients with high blood sugar levels on admission (in first 24 hours) faired badly in stroke. Stress hyperglycemia occurs following acute stroke and tends to decline in the first 8 hours and reaches the pre-stroke state by 48 hours. Whether normalising glucose levels in acute stage improved prognosis is a moot point.[46] Anderson et al showed that hyperglycemia worsened the cortical acidosis and reduced the mitochondrial

function in the ischemic penumbra. Hypoglycemia resulted in a significant reduction in the size of early infarcts as measured by TTC staining.[46,47,48]

In this study the mean blood sugar level was 119. Hyperglycemia clearly co-related with high mortality ($P < 0.05$) Moreover Glucose and insulin in stroke Trial (GIST) reported that GKI infusion can be safely administered to acute stroke patients and proved to be beneficial. If this is proved by a larger trial then GKI infusion may become the order of the day in stroke management.[50]

A strong relation between body temperature and functional outcome has been reported.[51] In the Copenhagen stroke study a 1°C decrease almost doubled the relative chance of a good functional outcome, independent of other factors. This study found a significant association between high admission temperatures and death. Experimental MCA occlusion in rats lasting 72 hours produced spontaneous hyperthermia.[52] Hypothalamic blood flow reduction after the occlusion was a likely factor for hyperthermia. Mild hypothermia significantly reduced the damage after focal ischemia in rats. Hypothermia (mild) prevented the changes in cortical potassium homeostasis and excitability that occurred following the ischemia. Hypothermia also attenuates the leukocyte migration towards chemotactic stimulus both in vivo and in vitro and thereby reducing the reperfusion injury compared with normothermia. The detrimental effects of hyperthermia and beneficiary effects of mild hypothermia are clearly proved in many studies.[51,52] Hence induction of mild hypothermia may become an aspiring therapeutic approach in stroke management in near future.

The Lausanne stroke registry comprising 3362 stroke patients predicts worsening of neurological state as an independent parameter for stroke mortality.[38] Tzong et al have shown that worsening of GCS is an independent indictor of mortality in stroke.[42]

Few studies have shown high osmolality[53] and hyponatremia to be one of the predictors of mortality in stroke especially in the elderly.[54] Hyponatremia may also manifest as altered sensorium and seizures. Seizures also occur due to location of the lesion either an infarct or hematoma, acting as an irritative focus. In this study it was found that persistent altered consciousness ($P < 0.01$) and seizures P (<0.01) doing hospital stay were independent predictors for early mortality.

Urinary incontinence has been shown to be an independent predictor for mortality among women in a study conducted at the Nulthrick Park Hospital.[55] Bandolier's prognostic index too uses this parameter in its score. This study also found that urinary incontinence was independently associated with mortality ($P < 0.01$). Similar results were obtained for dysphagia ($P < 0.01$).

Various studies have quoted aspiration pneumonitis to be an important causative factor for mortality in stroke patients.[56] The German stroke registry study group attributes 31.2% of deaths in 13440 ischemic stroke patients to pneumonia.[35] Aspiration pneumonia was found in almost all patients who died, in this study. The use of nasogastric tubes rather than longer tubes could contribute to this. Moreover patients are made to lie down flat on the first day of stroke in an attempt to improve cerebral perfusion.[57] The social custom of feeding milk though mouth in a critically ill patient could also contribute to

this. In many patients endotracheal tube intubation was deferred till the development of overt respiratory insufficiency. All these factors could increase the incidence of aspiration and it was shown to be an independent and important predictor of mobility in all acute stroke patients ($P < 0.01$).

Finally, it is emphasized that this study analysed whether stroke patients were alive or dead by 1 week and did not consider their long term mortality. So this mortality statistics could not be compared with the statistics of most studies which were long term follow-up studies. Even though mortality was considered as an end point in this study, the disability which may be present in patients who survived is still an important area to be addressed.

Perhaps the methods which could help to reduce mortality in acute stroke are

i) Early detection and adequate treatment of risk factors like hypertension and diabetes mellitus.

ii) Admission of patients to a stroke unit,

iii) Education of feeding practices in stroke patients and

iv) Chest physiotherapy (thereby preventing aspiration).

CONCLUSIONS

- Hemorrhagic strokes had a poor outcome than ischemic strokes.
- An elevated body temperature in the acute phase and hyperglycemia on admission were associated with a poor outcome.
- Diabetes and hypertension are not only risk factors for stroke but they were also clear predictors for early mortality.
- Increasing age of patients worsens prognosis and predicts early mortality.
- Conscious level was an independent predictor of outcome.
- Both Rodrigues and Joshi's score and Bandolier prognostic index are simple and reliable clinical prognostic scoring systems in early mortality in stroke.

SUMMARY

A total of 160 patients of anterior circulation stroke were analysed for various predictors of early mortality like age, hypertension, diabetes, previous stroke, altered level of consciousness, persistent altered consciousness, seizures, complete hemiplegia, dysphagia, urinary incontinence, raised body temperature and high blood sugar levels on admission. All these parameters were significantly associated with early mortality (i.e. death within 7 days). The mortality rate at the end of first week was 18.1%. Two clinical scoring systems viz. Rodrigues and Joshi's scoring system and Bandolier's prognostic index were used to prognosticate all those patients. Both were highly sensitive in predicting early mortality. A CT based scoring system was also used to prognosticate early mortality and was found to be useful.

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PROFORMA

Name Age Sex IP No.

Address Urban / Semi Urban / Rural

Time of onset of Stroke

Duration >6 hrs 6-24 hrs 1-3 days >3

H/o LOC Y/N
H/o Headache Y/N
H/o Vomiting Y/N
H/o Seizures Y/N
H/o Dysphagia Y/N

Symptoms Worsening / Static / Improving

H/o SHT Y/N

H/o DM Y/N

Previous H/o TIA / RIND / STROKE

Previous H/o CAD

Previous H/o MI

Previous H/o RHD

Other history :

Smoker / Alcoholic :

Examination : Conscious / Unconscious /
GCS
Pupils
Cranial N Involvement
Paucity of Movt.

Power R L
- UL
- LL

Plantar

Aspiration Pneumonitis

CT

Admission Temp.
Sugar ECG :
Urea Echo :
Creatinine Lipid Profile :
Na^+
K^+

Anti edema : 1) Mannitol
2) Furesemide
3) Both

Outcome on Day 7 Survival / Death

Rodrigues & Joshi's Score

Age (0.4 x age)

H/o. Pr. stroke Y/N

Mental Obundation Grade Y/N

Persistent altered consciousness Y/N

Altered conscious appearing in first 24 to 72 hrs	Y/N
Presence of complete hemiplegia	Y/N
Seizures during hospital stay	Y/N
Aspiration Pneumonitis	Y/N
Total Score	

CT Massive / Multiple Lesions	Y/N
Gross Mass effect	Y/N
Total Score	

Bandolier Prognostic Index

Impaired consciousness	5	Y/N
Urinary Incontinence	4	Y/N
Dysphagia	3	Y/N
Admission Temp. ≥ 100°F	2	Y/N
Hyperglycaemia in Non Diabetics	2	Y/N

ABBREVIATIONS

AF	-	Atrial fibrillation
APACHE	-	Acute physiology, age chronic health evaluation score.
AVM	-	Arterio venous malformation
BI	-	Barthel index
CAD	-	Coronary artery disease
CNS	-	Canadian Neurological Scale
CRP	-	C Reactive Protein
CT	-	Computed Tomography
CVA	-	Cerebrovascular Disease
DM	-	Diabetes mellitus
DVT	-	Deep Vein thrombosis
ECG	-	Electro cardiogram
EPSS	-	Early / Progressing stroke study
GIST	-	Glucose insulin in stroke Trial
GKI	-	Glucose potassium insulin infusion
HCD	-	Higher cerebral dysfunction
HT	-	Hypertension
ICT	-	Intra cranial tension
ICU	-	Intensive Care Unit
LMWH	-	Low molecular weight heparin
LOC	-	Loss of consciousness
MCA	-	Middle cerebral artery
MRI	-	Magnetic resonance imaging.

NIHSS	-	National Institute of Health Stroke Scale
PACS	-	Partial anterior circulation stroke
PWI	-	Perfusion weighted image
RIND	-	Reversible ischemic neurological Deficit
SSS	-	Scandinavian stroke scale
SPECT	-	Single Photon Emission Computed tomography.
TC DOPPLER	-	Trans Cranial Doppler
TIA	-	Transient ischemic attack
WBC	-	White Blood Cell Count.

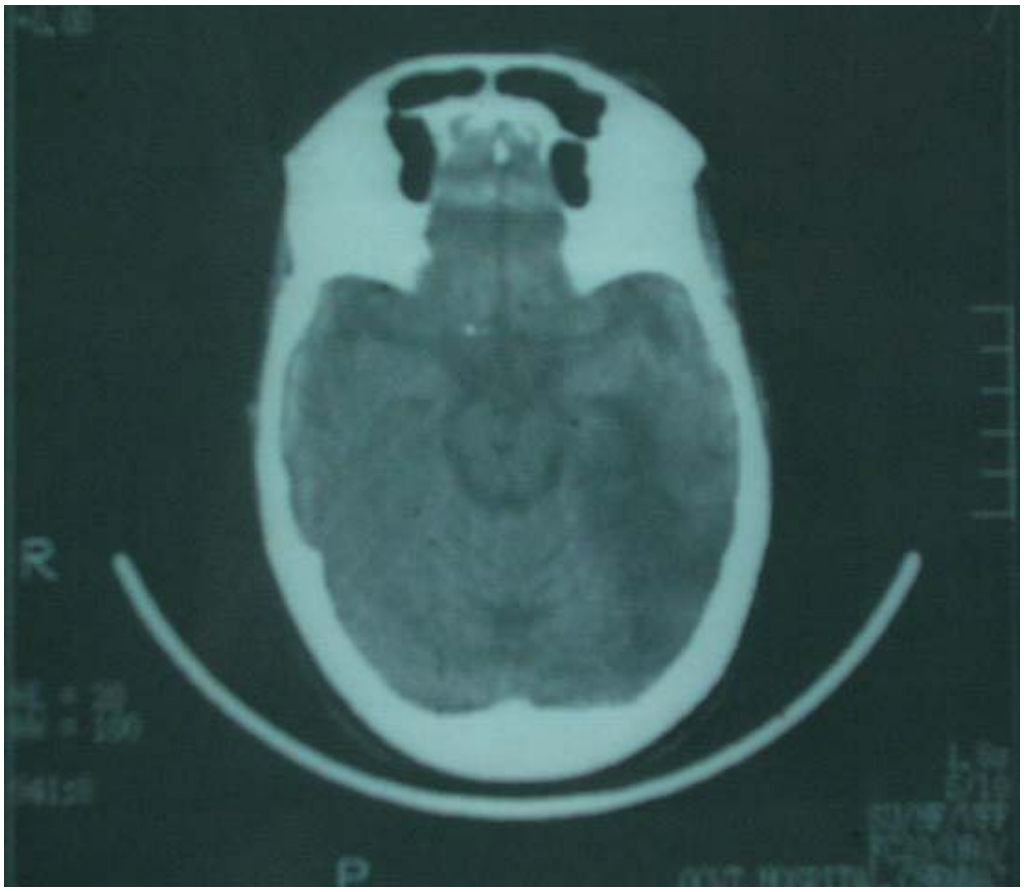

Figure - 1: A huge infarct in the Temperoparietal Region (Left)

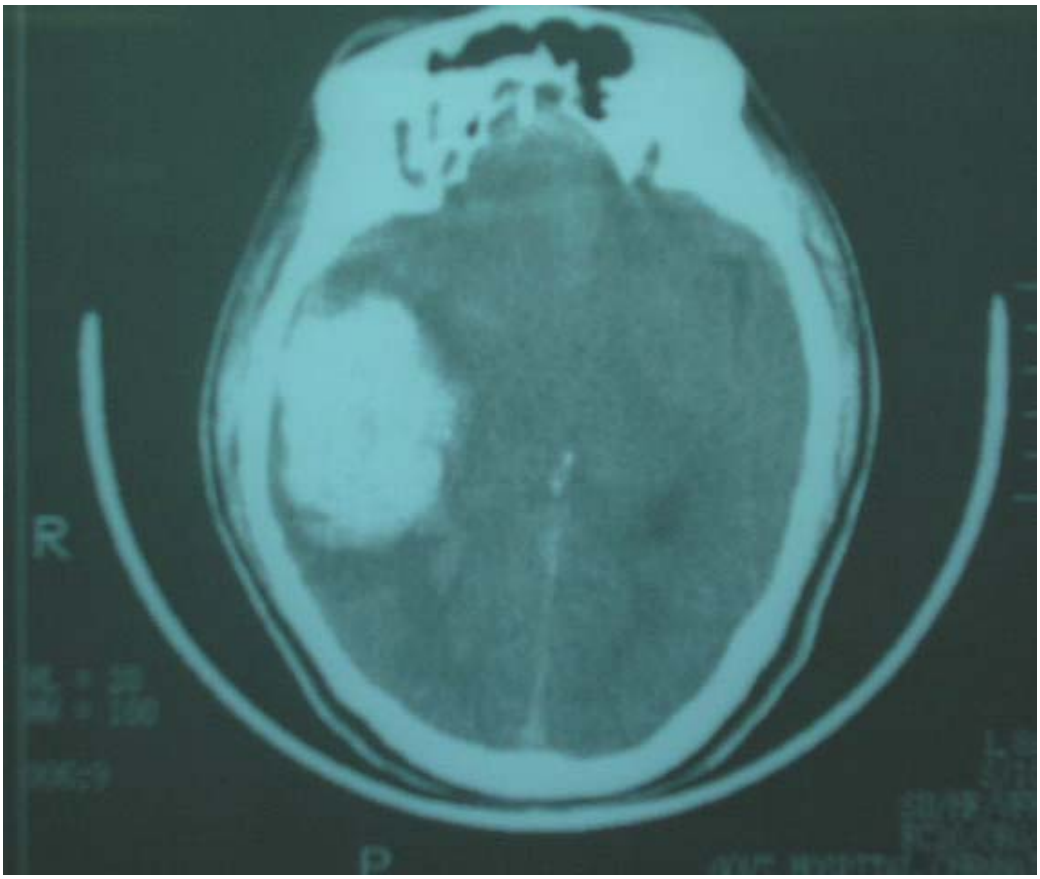

Figure - 2: A huge hemorrhage in the Parietal Region (Right)