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ORIGINAL RESEARCH

Study on diagnosis and assessment of acute stroke using national institute of health stroke scale(NIHSS)

[1]Dr. Gurwinderjit Singh, [2]Dr. Harpreet Singh, [3]Dr. Sat Pal Aloona, [4]Dr. Pashaura Singh Sandhu, [5]Dr. Divya B, [6]Dr. Nitesh

[1,5,6]Junior Resident, [2,3]Associate Professor, [4]Former Associate Professor, Department of Medicine, Guru Nanak Dev Hospital, Amritsar, Punjab, India

Corresponding Author
Dr. Harpreet Singh
Associate Professor, Department of Medicine, Guru Nanak Dev Hospital, Amritsar, Punjab, India

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Abstract

Background: Stroke, previously known as cerebrovascular accident (CVA), is now more accurately termed as a "brain attack" to emphasize its acute and potentially debilitating nature. It is defined as a sudden episode of focal neurological dysfunction persisting for more than 24 hours. Between 15% to 30% of stroke survivors experience permanent disability, and up to 20% require institutional care months after their stroke. The economic and psychological burdens associated with stroke are substantial, affecting individuals, families, and healthcare systems

Objective: To diagnose and assess the outcome of stroke using National Institute of Health Stroke Scale (NIHSS) and to study clinical and laboratory profile of stroke patients

Materials and methods: The observational prospective study was conducted on 100 patients with suspected diagnosis of acute stroke on the basis of National Institute of Health Stroke Scale (NIHSS) admitted through medicine emergency in the department of medicine of Guru Nanak Dev Hospital attached to Govt. Medical College, Amritsar during the period of 1 year (2023-24)

Results: Maximum patients were in 61-70 yr age group (30%) with mean age being59.26±12.246 with a standard error of 1.226. Most common type of stroke was ischemic stroke (64%). Mean duration of hospital stay was 6.03±4.441 days. Maximum patients had moderate severity (67%) with NIHSS score from 05-15. Mean NIHSS score in study population was 12.22±6.397. Statistical analysis revealed a significant positive association between NIHSS score and patient's age with a p value of 0.0254. Statistical analysis of duration of hospital stay and NIHSS score also revealed a significant positive association with a p value of 0.00012. Acute stroke outcome was observed in study participants, 56% patients were discharged home independently while 38% required some form of assistance. 4% patients expired during the hospital stay. Significant positive association was found between acute stroke outcome and NIHSS score on statistical analysis (p value 0.001). 30 day follow up of study participants was done and outcome was recorded. Relationship of NIHSS score and 30 day outcome was statistically significant with a p value of 0.001.

Conclusion: The study affirmed that NIHSS is a highly comprehensive scale for diagnosing and evaluating stroke severity, with each component testing specific neurological functions. The scale's objectivity ensures consistent interpretation among physicians and neurologists. It was concluded that NIHSS is valuable for assessing stroke severity, with the baseline NIHSS

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score upon admission serving as a predictor of both acute stroke outcome and 30-day prognosis.

Introduction

Stroke, previously known as cerebrovascular accident (CVA), is now more accurately termed as a "brain attack" to emphasize its acute and potentially debilitating nature. It is defined as a sudden episode of focal neurological dysfunction persisting for more than 24 hours(1). Stroke represents a significant global health challenge, ranking as the second leading cause of death worldwide and the leading cause of long-term disability(2). Efforts to track stroke incidence and mortality have shown a troubling increase in stroke-related deaths over recent decades, with nearly 5.87 million stroke deaths globally reported in 2010—an increase of 26% from 1990(3,4).

The incidence of stroke is disproportionately higher in low- and middle-income countries, including India. In India, stroke ranks as the fifth leading cause of disability-adjusted life years(5). The prevalence of stroke in India is estimated to be around 2%, according to the WHO-SAGE study(6). Crude incidence rates vary across different regions of India, ranging from 108 to 172 cases per 100,000 people per year. Similarly, crude prevalence rates range widely from 26 to 757 cases per 100,000 people per year. One-month case fatality rates after stroke onset in India typically range from 18% to 42%, highlighting the severity of the condition and the challenges in managing acute stroke cases effectively(7).

Stoke risk factors

Stroke can affect anyone at any age, but certain factors increase the likelihood of having a stroke. These risk factors are categorized into non-modifiable and modifiable types.

Non-modifiable risk factors include age, race, ethnicity, gender, and genetics. Stroke incidence increases significantly with age, doubling for each decade after 55 years. However, there has been a rise in ischemic stroke cases among younger adults aged 20 to 54 due to factors like obesity, high blood pressure, and diabetes. Approximately one in seven strokes occur in individuals aged 15 to 49(8). Women have a higher lifetime risk of stroke compared to men, with a 1 in 4 chance for women after age 25(10). Pregnancy and contraceptive pill use increase stroke risk in women. Genetic factors, including family history, also play a role. Hispanic and Black populations generally at higher risk than White populations(9).

Modifiable Risk Factors for Stroke: Several risk factors for stroke can be modified through lifestyle changes and medical interventions:

High Blood Pressure (Hypertension): Hypertension is a significant risk factor for stroke. Studies have demonstrated that reducing blood pressure (BP) by 5–6 mm Hg can lower the relative risk of stroke by 42%(10).

Diabetes: Diabetic individuals tend to have worse outcomes after stroke, including higher rates of severe disability and slower recovery. Impaired glucose tolerance also increases the risk of stroke in non-diabetic patients with transient ischemic attacks (TIAs) or minor ischemic stroke (11). The duration of diabetes is independently associated with an increased stroke risk, with a 3% annual increase and tripling after 10 years of diabetes (12).

Hyperlipidemia: Total cholesterol is associated with stroke risk, while high-density lipoprotein (HDL) decreases stroke incidence (13). Managing lipid levels is crucial for reducing stroke risk.

Alcohol Consumption: Low to moderate alcohol consumption (≤2 standard drinks daily for men, ≤1 for women) reduces stroke risk, but high intake increases it. Even low alcohol consumption elevates the risk of hemorrhagic stroke (14).

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Tobacco Smoking: Smoking doubles the risk of stroke compared to non-smokers. Quitting smoking significantly reduces the relative risk of stroke, whereas prolonged exposure to second-hand smoke increases the risk by 30% (15).

Physical Inactivity and dietary factors: Insufficient exercise is associated with increased stroke risk and is linked to conditions like hypertension, obesity, and diabetes, all of which contribute to higher stroke incidence.

NATIONAL INSTITUTES OF HEALTH STROKE SCALE (NIHSS): The National Institutes of Health Stroke Scale (NIHSS) is a standardized tool used to assess and quantify neurological deficits in stroke patients. Originally developed by Thomas Brott et al in 1989 (16), the NIHSS was used as a primary tool for measuring and documenting stroke severity and outcomes in stroke therapy trials and the NINDS r-tPA trial in 1995 (17). The scale was altered and refined by the National Institutes of Health (NIH), resulting in its current form known as the National Institutes of Health Stroke Scale (NIHSS). This alteration involved revisions and improvements based on feedback and clinical trial outcomes, ultimately establishing the NIHSS as a standardized tool for assessing and quantifying stroke-related neurological deficits. This scale consists of 11 items (expandable to 15), evaluating various aspects of neurological function through 13 specific tests.Each test item is scored from 0 (normal function) to 4 (severe impairment), with a maximum total score of 42.

Administration and Scoring

- The scale can be administered by physicians, nurses, or therapists in less than 10 minutes at the bedside(18).
- Each test item assesses specific neurological functions such as level of consciousness, visual fields, motor abilities of limbs, sensory function, language skills, and neglect
- Scores for each item are summed to derive a total NIHSS score. A score of ≥16 indicates a high probability of death or severe disability, while ≤6 forecasts a good recovery (19).
- The scale includes provisions for untestable items (UT), ensuring flexibility in assessment based on patient condition.

Stroke severity based on NIHSS is classified as:

0-4 : Minor stroke
5-15 : Moderate stroke
16-20 : Moderate to severe stroke
21-42 : Severe stroke

The NIH Stroke Scale (NIHSS) is a critical tool in assessing stroke severity and guiding treatment decisions. However, its validity can be impacted by several factors:

1. Language Barrier: The NIHSS heavily relies on verbal communication to assess language abilities, which may be compromised if there is a language barrier between the patient and the examiner.
2. Previous Neurological Deficit: Patients with pre-existing neurological deficits may already have impairments in certain NIHSS domains, potentially affecting the accuracy of the assessment.
3. Intubation: Patients who are intubated may not be able to follow commands related to vision, facial movements, or speech, which are essential components of the NIHSS assessment.

Stroke outcome

Stroke can result in lasting disability and reduced quality of life, impacting a person's capacity to manage everyday activities. Stroke outcomes are categorized based on neurological impairments. The American Heart Association has devised a classification system that assesses outcomes across six neurological domains: motor function, sensory

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function, vision, affect (emotional response), cognition, and language. The severity of impairment is classified into levels: Level A indicates minimal neurological deficits in any domain; Level B signifies mild to moderate deficits in one or more domains due to stroke; Level C denotes severe deficits in one or more domains resulting from stroke.

Materials and methods

This observational prospective study was conducted on 100 patients with suspected diagnosis of acute stroke on the basis of National Institute of Health Stroke Scale (NIHSS) admitted through medicine emergency in the department of medicine of Guru Nanak Dev Hospital attached to Govt. Medical College, Amritsar during the period of 1 year (2023-24). The study was carried out after seeking permission from Institutional Ethics Committee, Government Medical College, Amritsar. Written informed consent was obtained from the patients.

Inclusion criteria:

1. Patients diagnosed with Stroke using NIHSS (score>3) with atleast one of the clinical features like facial paresis, leg paresis, arm paresis or aphasia.
2. Symptoms of stroke not lasting more than 7 days.

Exclusion criteria

1. Stroke symptoms lasting more than 7 days.
2. Past history of stroke.

Methodology

A total of 100 patients were taken. All the patients were recruited from Medicine department admitted through emergency of Guru Nanak Dev Hospital, Government Medical College, Amritsar on basis of NIHSS. Recruited patients were enrolled based on exclusion and inclusion criteria. All the patients diagnosed to have stroke were thoroughly examined and evaluated in detail. Elaborate history was taken. Age, sex, family history, history of TIA's was recorded. Presence of risk factors like systemic hypertension, diabetes mellitus, alcohol intake, cigarette smoking, ischemic heart disease and rheumatic heart disease was noted. Symptoms of stroke like altered level of consciousness, speech dysfunction, gait disturbance, convulsions, headache and vomitings were recorded. Detailed clinical examination was done and signs like hemiparesis, facial paralysis, sensory deficit, hemianopia, diplopia were recorded. NIHSS was applied on all patients suspected to have stroke first on admission and then at the time of discharge/referral/ death to assess stroke severity. All the patients were subjected to CT-SCAN brain/MRI Brain and report was compared with NIHSS score. All the patients were followed up for a period of 30 days to assess the final outcome. Final outcome was compared with admission NIHSS.

Investigations performed were

1. Complete Hemogram:
- Hemoglobin (g/dL)
- Total Count (cells/cmm)
- Differential Count
- PCV
- Platelets (lakhs/cmm)
2. Random blood sugar
3. Liver function tests and Renal function tests
4. Electrocardiography
5. Lipid profile
- Serum Triglycerides

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- Serum LDL
- Serum HDL
- Serum VLDL

6. CT scan brain/MRI Brain

Statistical analysis

The data was collected systematically and after entering in Microsoft excel sheet, it was analyzed using appropriate SPSS 20 software.

Continuous variables were expressed as mean±S.D. and categorized variables as counts and percentage.

Results

TABLE 1: AGE WISE DISTRIBUTION OF PATIENTS

AGE	FEMALES	MALES	TOTAL	PERCENTAGE
30-40	2	8	10	10%
41-50	7	12	19	19%
51-60	17	9	26	26%
61-70	21	9	30	30%
71-80	9	3	12	12%
81-90	2	1	3	3%
Total	58	42	100	100%

Table 1 shows age wise distribution of patients, 10 (10%) patients were in 30-40 yrs age group, 19 (19%) patients were in the age group of 41-50 yrs, 26 (26%) patients were in 51-60 yrs age group, 30 (30%) patients were in 61-70 age group, 12 (12%) patients were in 71-80 age group and 3 (3%) patients were in 81-90 age group. Mean age of patients was 59.26±12.246 with a standard error of 1.226.

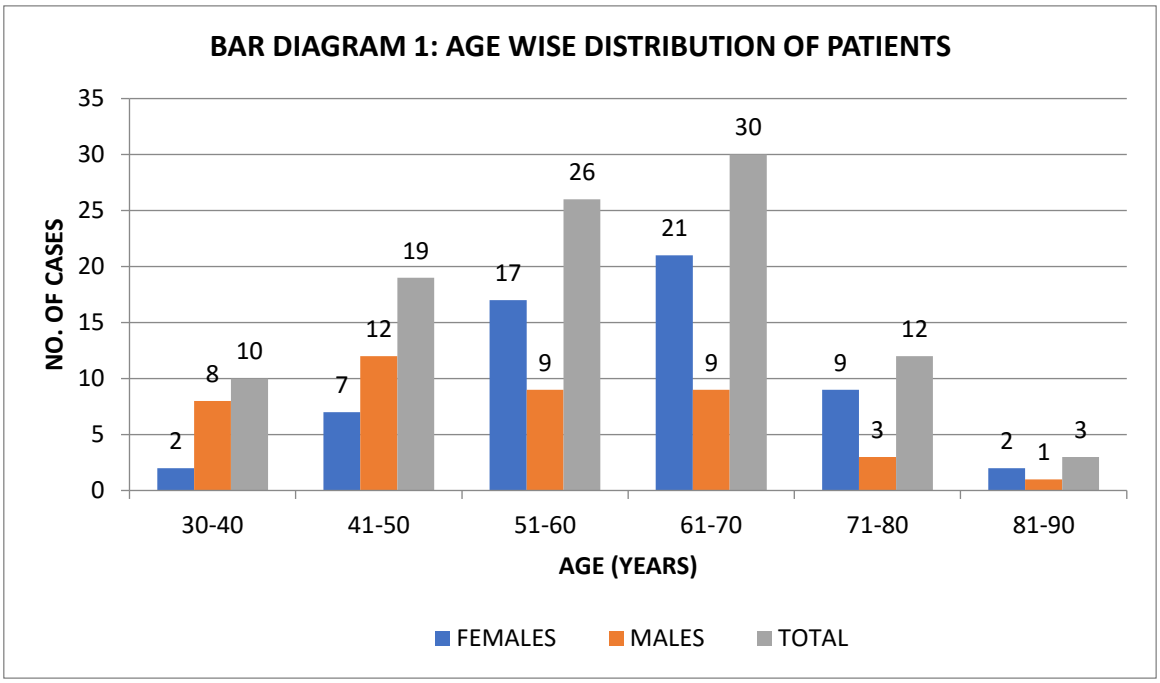

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TABLE 2: RISK FACTORS IN STROKE PATIENTS

RISK FACTORS	NUMBER	PERCENTAGE
SYSTEMIC HYPERTENSION	59	59%
DIABETES MELLITUS	37	37%
ALCOHOLISM	20	20%
SMOKING	14	14%
HYPERCHOLESTEROLEMIA	11	11%
H/O TRANSIENT ISCHEMIC ATTACKS	7	7%
RHEUMATIC HEART DISEASE	2	2%
FAMILY HISTORY	5	5%
NO RISK FACTOR	20	20%

Table 2 shows risk factors and systemic diseases associated with acute stroke in study population. Systemic hypertension was present in 59 (59%) patients being the commonest risk factor followed by 37 (37%) patients with diabetes mellitus and 20 (20%) patients with alcoholism. 14 (14%) patients were smokers, 11 (11%) had hypercholesterolemia. History of TIA's was present in 7 (7%) patients and 5 (5%) patients had family history of stroke. In 20 (20%) patients, no risk factor was present. More than 1 risk factor was present in many patients.

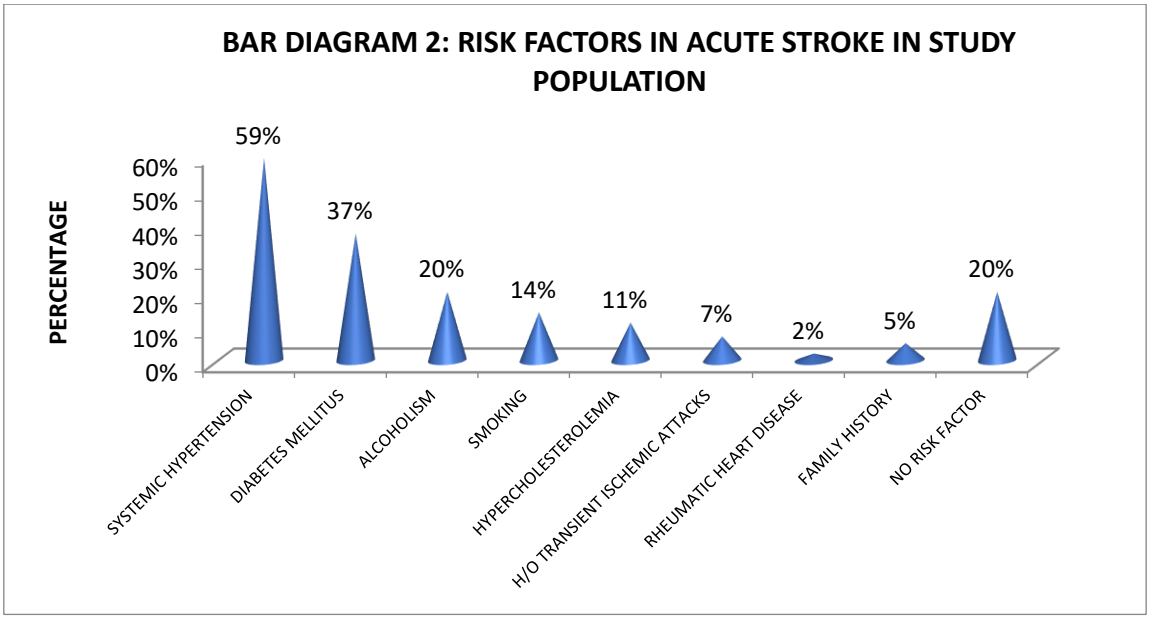

TABLE 3: DURATION OF HOSPITAL STAY IN STROKE PATIENTS

DURATION OF HOSPITAL STAY	N	Mean ± SD
0-5 DAYS	54	3.037±1.24
6-10 DAYS	30	6.833±0.95
10-15 DAYS	10	12.60±1.43
15-20 DAYS	5	17.20±1.79
>20 DAYS	1	22.00±0.00

In stroke patients, duration of hospital stay of maximum patients was 1-5 days. Minimum duration was 2 days and maximum duration was 22 days. Mean duration of hospital stay was 6.03±4.441.

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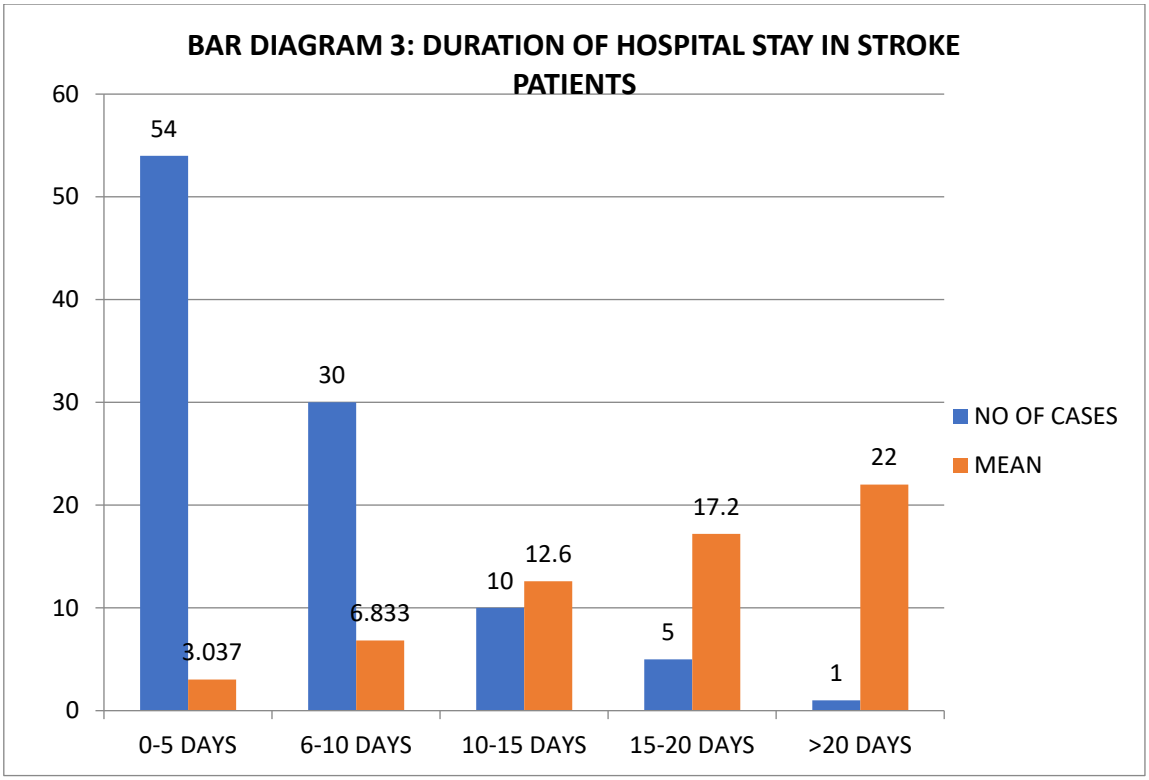

TABLE 4: SEVERITY ACCORDING TO NATIONAL INSTITUTE OF HEALTH STROKE SEVERITY (NIHSS) SCALE AT ADMISSION

STROKE SEVERITY	NIHSS SCORE	NUMBER
Minor Stroke	01-04	12
Moderate Stroke	05-15	67
Moderate to severe stroke	16-20	09
Severe stroke	21-42	12

Table 4 shows severity of stroke according to NIHSS score at admission, 12 patients had minor stroke, 67 patients had moderate stroke, 09 patients had moderate to severe stroke and 12 patients had severe stroke. Maximum patients had moderate severity according to admission NIHSS. Mean NIHSS score was 12.22±6.397.

TABLE 5: ASSOCIATION OF STROKE SEVERITY ACCORDING TO ADMISSION NIHSS AND AGE GROUP

	NIHSS Score			
AGE (IN YEARS)	1 to 4	5 to 15	15 to 20	21 to 42
30-40	2	6	0	1
40-50	5	15	0	0
50-60	2	20	2	2
60-70	3	20	5	3
70-80	0	5	1	5
81-90	0	1	1	1

Chi Square: 32.41; P-Value: 0.0254; DF= 8

Table 5 shows analysis of relation between NIHSS score and patient's age. On statistical analysis, the relation between NIHSS and age was found to be statistically significant with a P value of 0.0254.

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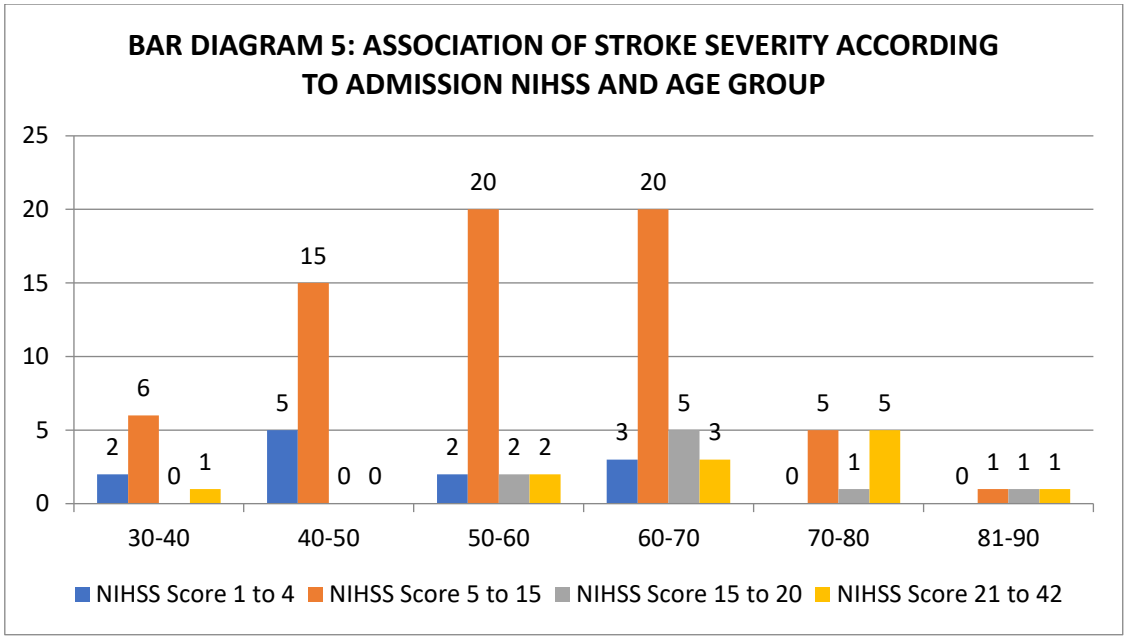

TABLE 6: ASSOCIATION OF STROKE SEVERITY ACCORDING TO ADMISSION NIHSS AND DURATION OF HOSPITAL STAY

DURATION OF HOSPITAL STAY	Admission NIHSS			
	1 to 4	5 to 15	16 to 20	21 to 42
0-5 DAYS	12	36	0	6
6-10 DAYS	0	29	1	0
10-15 DAYS	0	2	6	2
15-20 DAYS	0	0	2	3
>20 DAYS	0	0	0	1

Chi Square: 81.962, DF:12, P value:0.00012

On statistical analysis of stroke severity according to admission NIHSS and duration of hospital stay, significant positive association was found with a P value of 0.00012.

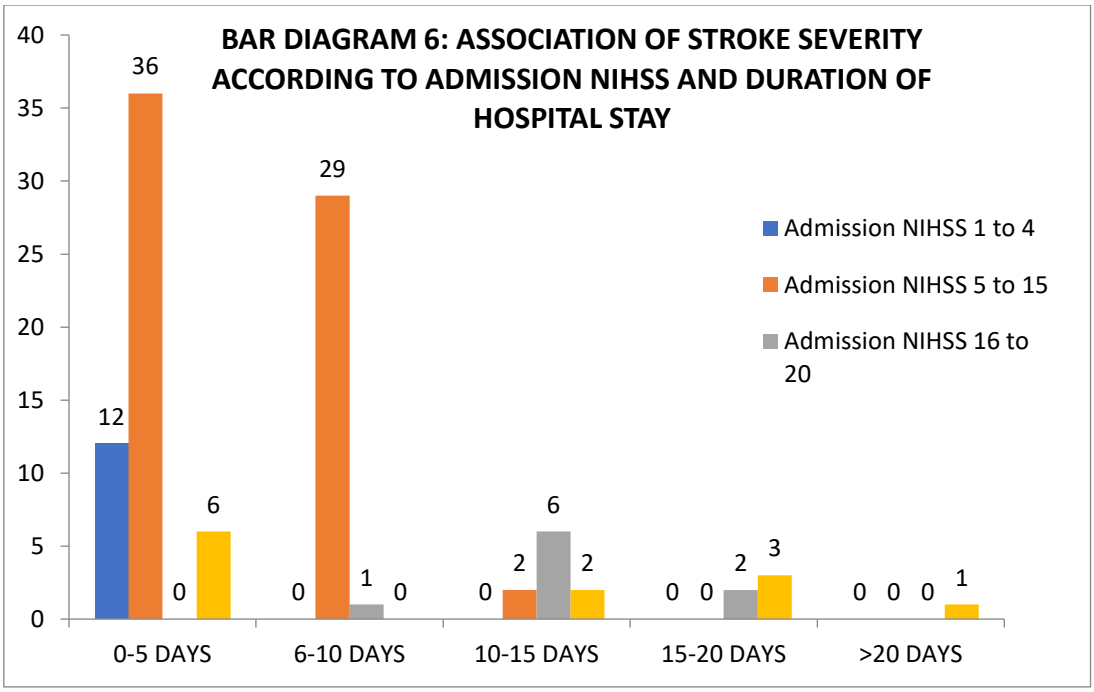

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TABLE 7: ACUTE STROKE OUTCOME

ACUTE STROKE OUTCOME	NUMBER	PERCENTAGE
DISCHARGE HOME INDEPENDENT	56	56%
DISCHARGE HOME ASSISTANCE	38	38%
EXPIRED	06	6%

In our study, acute stroke outcome was calculated and 56% patients that were discharged needed no assistance at home whereas 38% patients that were discharged needed some assistance at home. Out of 100 patients, 6 patients died in the hospital only.

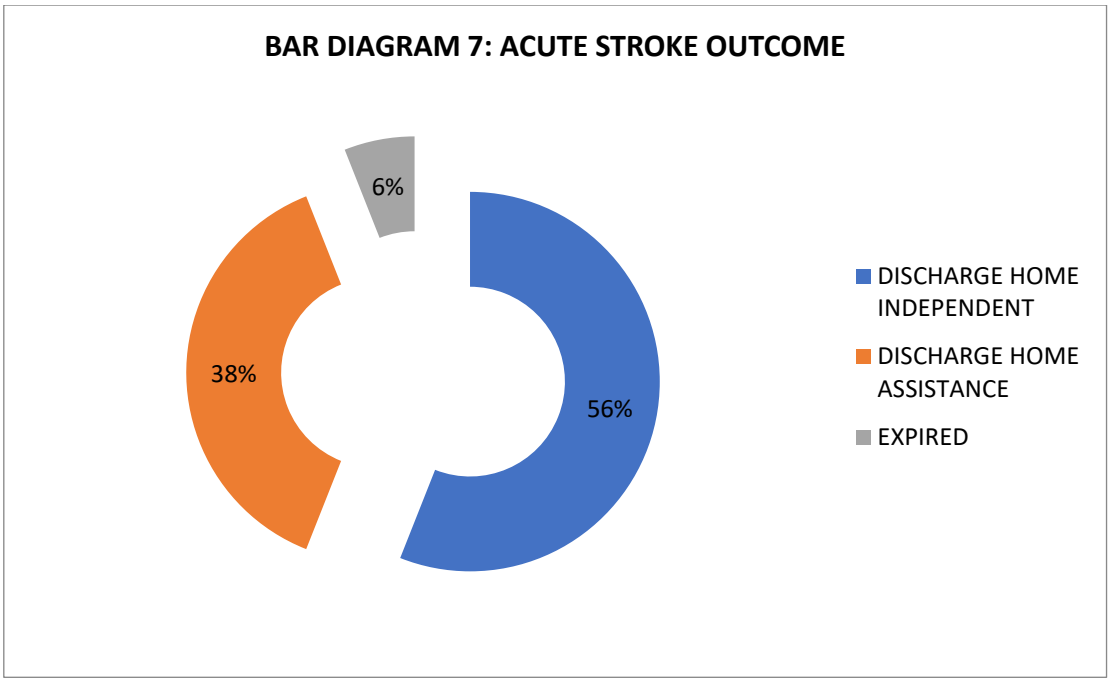

TABLE 8: ASSOCIATION OF STROKE SEVERITY ACCORDING TO ADMISSION NIHSS AND ACUTE STROKE OUTCOME

	NIHSS Score	DISCHARGE HOME ASSISTED (DHA)	DISCHARGE HOME INDEPENDENT (DHI)	EXPIRED
Minor Stroke	01-04	0	12	0
Moderate Stroke	05-15	24	43	0
Moderate to severe Stroke	16-20	8	1	0
Severe Stroke	21-42	6	0	6

Chi Square: 70.1392; P-Value: 0.001; DF= 6

Table 8 shows association of admission NIHSS score with acute stroke outcome. On statistical analysis, significant positive association was found between NIHSS score and acute stroke outcome with a P value of 0.001.

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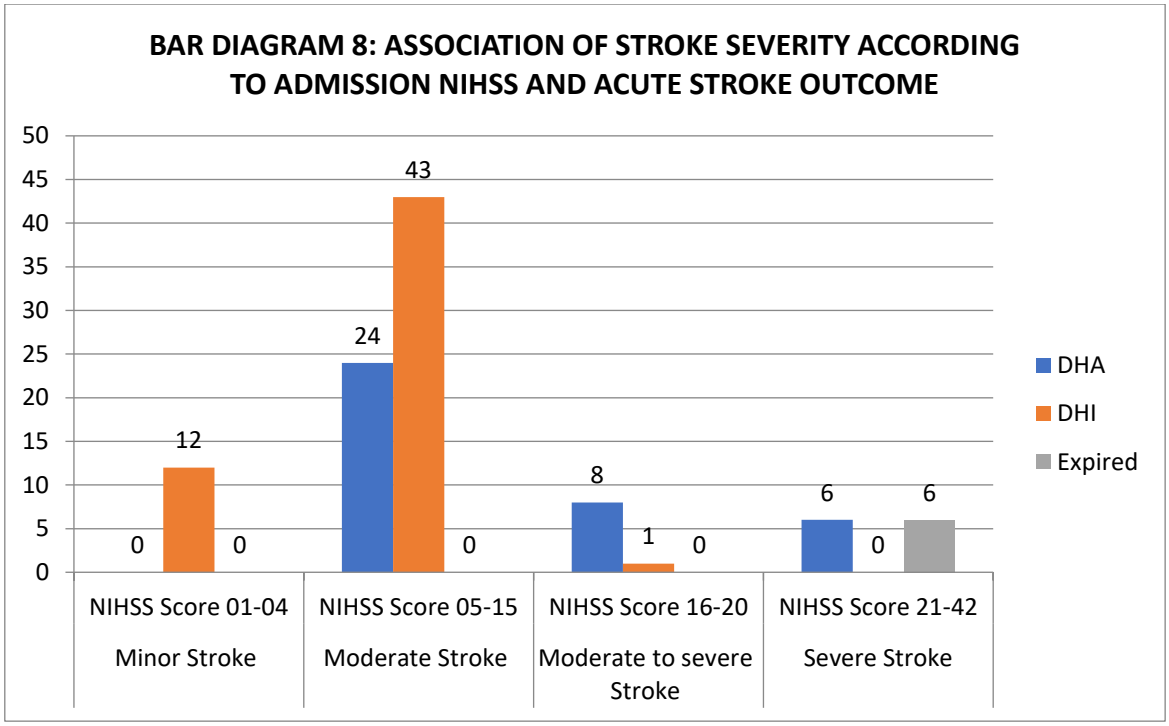

TABLE 9: 30 DAY OUTCOME IN ACUTE STROKE PATIENTS

OUTCOME	NUMBER	PERCENTAGE
EXPIRED	10	10%
FULL RECOVERY	21	21%
MINOR IMPAIRMENT	22	22%
MODERATE IMPAIRMENT	36	36%
SEVERE IMPAIRMENT	11	11%

Table 9 shows 30 day outcome in acute stroke patients which was calculated on the basis of AHA stroke outcome classification. 21 patients were found to be fully recovered after 30 days, 69 patients had impairment which was minor in 22, moderate in 36 and severe in 11. Out of 100 patients, a total of 10 patients expired within 30 days after the acute stroke.

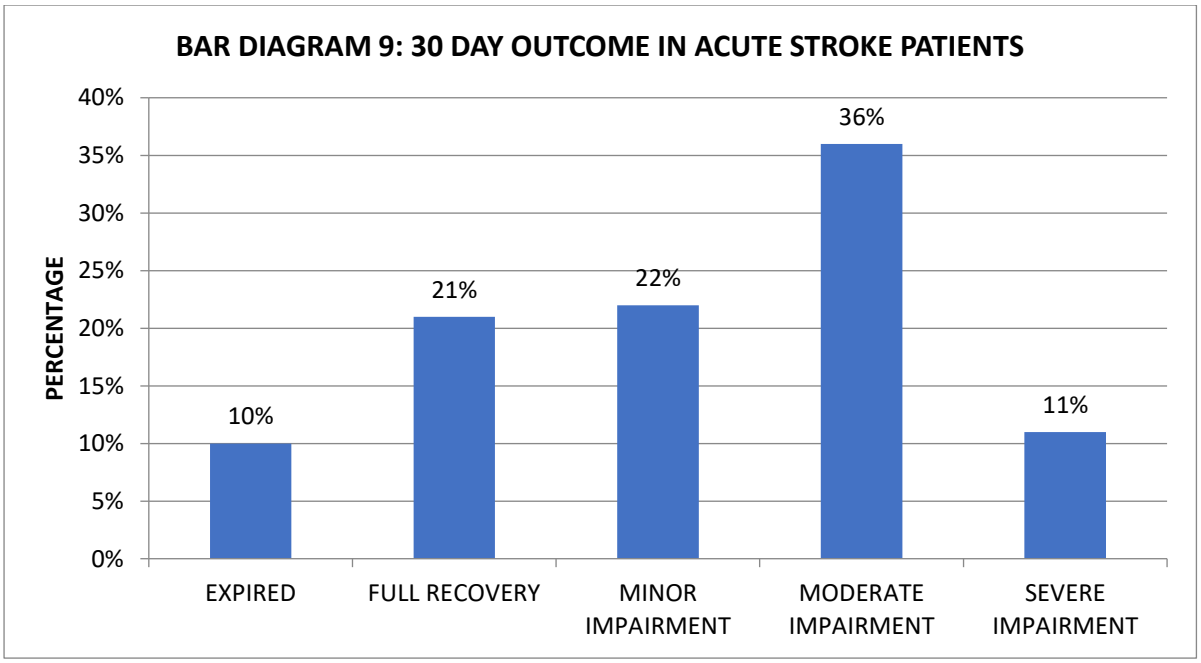

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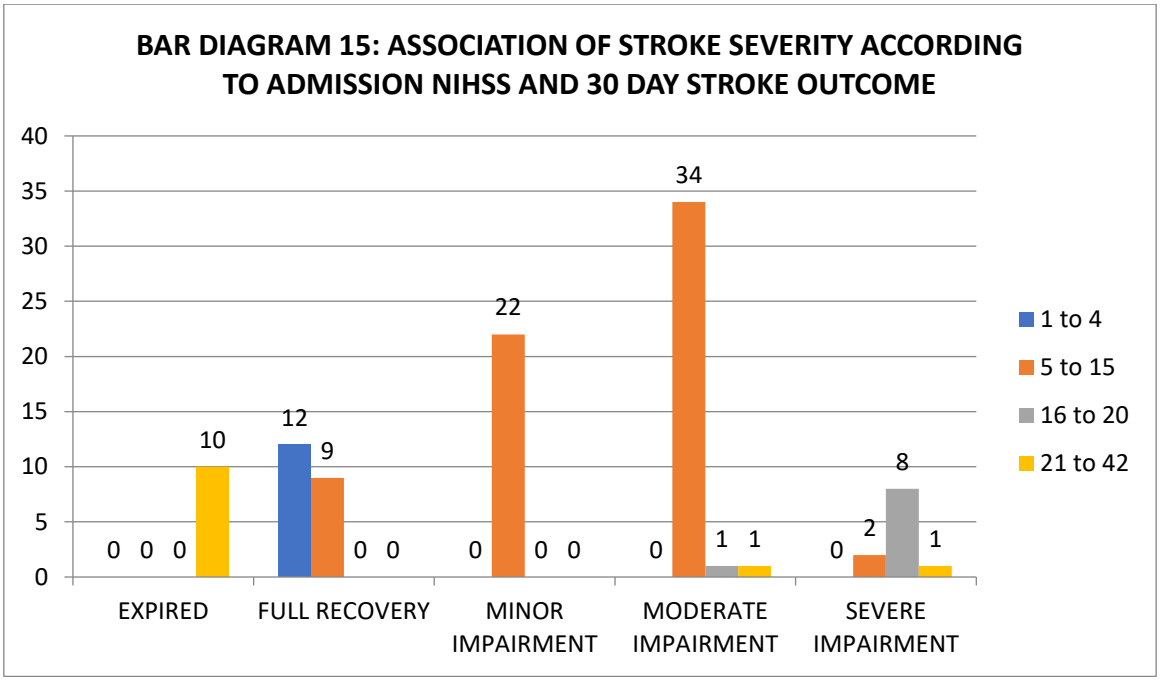
TABLE 10: ASSOCIATION OF STROKE SEVERITY ACCORDING TO ADMISSION NIHSS AND 30 DAY STROKE OUTCOME

NIHSS Score	1 to 4	5 to 15	15 to 20	21 to 42
EXPIRED	0	0	0	10
FULL RECOVERY	12	9	0	0
MINOR IMPAIRMENT	0	22	0	0
MODERATE IMPAIRMENT	0	34	1	1
SEVERE IMPAIRMENT	0	2	8	1

Chi Square: 193.48; P-Value: 0.001; DF= 12

Table 10 shows statistical analysis between NIHSS score at admission and 30 day outcome of stroke patients. Relationship was found to be statistically significant with P value of 0.001.



Discussion

The aim of our study was diagnosis and assessment of acute stroke using National Institute of Health Stroke Scale and to study clinical and laboratory profile of acute stroke patients. We analysed the distribution of patients based on age, sex, CT findings, mode of onset of stroke, symptoms, signs, risk factors, duration of hospital stay and acute outcome and outcome after 30 days of stroke.

A total of 100 patients were taken and divided according to sex. Out of 100 patients, 58 patients (58%) were females and 42 patients (42%) were males. Stroke was more common among women than men .

Patients were then distributed according to age. 10 patients (10%) were in 30-40 yrs age group, 19 patients (19%) were in the age group of 41-50 yrs, 26 patients (26%) were in 51-60 yrs age group, 30 patients (30%) were in 61-70 age group, 12 patients (12%) were in 71-80 age group and 3 patients (3%) were in 81-90 age group. Maximum patients were in 61-70 yrs age group. the Mean age of patients was 59.26±12.246 with a standard error of 1.226.

When distributed based on CT scan findings. 64 patients (64%) had ischemic stroke, 19 patients (19%) had haemorrhagic stroke, 2 patients (2%) had embolic stroke and 11 patients (11%) had lacunar stroke. Out of all patients, 4 patients had no finding on CT scan. Ischemic stroke was most common.

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Symptoms of acute stroke were studied. Maximum patients had gait disturbance i.e 92 (92%), followed by speech disturbance in 75 patients (75%) and altered level of consciousness in 51 (51%) patients. 8 (8%) patients had vomitings, 7 (7%) patients had headache and 5 (5%) patients had convulsions.

When signs of acute stroke were studied, Most common sign was Hemiparesis was which was present in 89 patients (89%) followed by facial paralysis in 72 patients (72%) and aphasia in 39 patients (39%). 7 patients (7%) had coma, hemianopia was present in 2 patients (2%), sensory deficit in 1 patient (1%) and monoparesis in 1 patient (1%).

Mode of onset of stroke was noted in study population. Onset was sudden in 89% patients, while in 5% patients mode of onset was remitting type, 5% had progressive and 1% had fluctuating type. Commonest mode of onset was sudden with maximal deficit.

Patients were then distributed according to risk factors and systemic diseases associated with acute stroke. Systemic hypertension was present in 59 patients (59%) being the commonest risk factor followed by 37 patients (37%) with diabetes mellitus and 20 patients (20%) with alcoholism. 14 patients (14%) were smokers, 11 patients (11%) had hypercholesterolemia. History of TIA's was present in 7 patients (7%) and 5 patients (5%) had family history of stroke. In 20 patients (20%) no risk factor was present.

Patients were distributed according to severity of stroke according to NIHSS score at admission, 12 patients had minor stroke, 67 patients had moderate stroke, 09 patients had moderate to severe stroke and 12 patients had severe stroke. Maximum patients had moderate severity according to admission NIHSS.

When distributed according to duration of hospital stay, maximum hospital stay of patients was 1-5 days. Minimum duration was 2 days and maximum duration was 22 days. Mean duration of hospital stay was 6.03±4.441. Statistical analysis of stroke severity according to admission NIHSS and duration of hospital stay and significant positive association was found with a P value of 0.00012.

Similarly, statistical analysis was done to determine association between NIHSS score and patient's age. The relation between NIHSS and age was found to be statistically significant with a P value of 0.005.

In our study, acute stroke outcome was calculated and 56% patients that were discharged needed no assistance at home whereas 38% patients that were discharged needed some assistance at home. Out of 100 patients, 6 patients died in the hospital only. Association of admission NIHSS score with acute stroke outcome was determined. On statistical analysis, significant positive association was found between NIHSS score and acute stroke outcome with a P value of 0.001.

30 day outcome in acute stroke patients was calculated. 21% patients were found to be fully recovered after 30 days, 69 patients had impairment which was minor in 22, moderate in 36 and severe in 11. Out of 100 patients, a total of 10% patients expired within 30 days after the acute stroke. Some of the most common disabilities that can occur after a stroke include difficulties with speech, reduced physical abilities, weakness or paralysis on one side of the body, challenges with gripping or holding objects, and a slowed ability to communicate effectively.

On statistical analysis between NIHSS score at admission and 30-day outcome of stroke patients. Relationship was found to be statistically significant with P value of 0.001.

Conclusion

In present study, our aim was diagnosis and assessment of acute stroke using National Institute of Health Stroke Scale. We recruited patients with suspected diagnosis of acute stroke on the basis of National Institute of Health Stroke Scale (NIHSS) from the Department of Medicine of Guru Nanak Dev Hospital attached to Govt. Medical College, Amritsar.

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Patients were divided into groups based on age, sex, types of stroke, past medical history, risk factors, signs, symptoms, mode of onset of stroke, duration of hospital stay, admission NIHSS score, acute stroke outcome and outcome at 30 days after stroke.

The study affirmed that NIHSS is a highly comprehensive scale for diagnosing and evaluating stroke severity, with each component testing specific neurological functions. The inclusion of untestable items allows flexibility in its application. Its bedside administration facilitates rapid diagnosis and early intervention. The scale's objectivity ensures consistent interpretation among physicians and neurologists.

It was concluded that NIHSS is valuable for assessing stroke severity, with the baseline NIHSS score upon admission serving as a predictor of both acute stroke outcome and 30-day prognosis. Additionally, baseline NIHSS score proved useful in predicting mortality following stroke. Therefore, NIHSS should be routinely calculated in all acute stroke patients.

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