Type of Article: Original Research Article

A STUDY OF 100 CONSECUTIVE CASES OF STROKE AT A GOVERNMENT GENERAL HOSPITAL

Dr S NARASIMHA MURTY [1], Dr S S V V NARASINGA RAO [2],

Dr CHINTADA SRUTHI KEERTHI[3], Dr A S VEERAMANI KARTHEEK*[4]

[1] Associate Professor, Department of General Medicine, Government Medical College, Srikakulam

[2] Assistant Professor, Department of General Medicine, Government Medical College, Srikakulam

[3] Assistant Professor, Department of General Medicine, Government Medical College, Srikakulam

[4] Assistant Professor, Department of General Medicine, Andhra Medical College, Visakhapatnam.

*Corresponding author:

Dr. A S Veeramani Kartheek

Assistant Professor Department of General Medicine, Andhra Medical College

Maharanipeta, Visakhapatnam Andhra Pradesh (530002) India

Phone (or Mobile) No.: +91-9703586435

Email: kartheek.asvm@gmail.com

ABSTRACT

World Health Organization(WHO) defines Stroke as a condition characterised by rapidly developing symptoms and signs of a focal brain lesion, with symptoms lasting for >24 hours or leading to death due to vascular etiology. Stroke is India's fourth leading cause of death and fifth leading cause of disability. In the present study we aim to study the clinical presentation and outcome of patients admitted with stroke in our hospital. A prospective hospital-based study of 100 consecutive stroke cases admitted to Government General Hospital, Srikakulam during the study period was conducted. The clinical profile and outcome of the patients were assessed. Among the hundred patients in the present study, 60% were males and 40% were females and about one third of the patients (32%) aged above 60 years. Hypertension (61%), Dyslipidemia (34%) and Diabetes mellitus (32%)were the commonly encountered comorbidities. Motor weakness in the form of hemiplegia/hemiparesis (74%) and impaired consciousness (56%) were most frequent presenting symptoms of stroke patients. The mortality rate in the present study was 36%. Older age, male gender, low GCS score at presentation, haemorrhagic stroke with intra ventricular extension of bleed and mass effect with midline shift were associated with the poor outcome of stroke. ($p < 0.05$). Ischemic stroke (76%) is the most common type of stroke in the present study. About one third of the patients (36%) succumbed to death. It is crucial to manage risk factors and comorbidities adequately to prevent occurrence of stroke.

Keywords: Stroke, Ischemic stroke, Haemorrhagic stroke, hemiplegia, stroke mortality, complications of stroke

Introduction

Stroke is defined by the World Health Organization(WHO) as a condition characterised by rapidly developing symptoms and signs of a focal brain lesion, with symptoms lasting for greater than 24 hours or leading to death, with no apparent etiology except that of vascular origin. Transient ischaemic attacks (TIAs), where symptoms last less than 24 hours, may be a precursor of a stroke.[1] Stroke is a significant global health problem and a major cause of mortality and morbidity. It is the second most common cause of death worldwide, preceded only by ischemic heart disease, and the

third most common cause of disability.[2] Seventy percent of strokes occur in low-middle income countries, and the subsequent disease burden is greater than that of high-income countries. Life expectancy in India has recently increased to over 60 years of age leading to an increase in age-related, non-communicable diseases including stroke, making stroke India's fourth leading cause of death and fifth leading cause of disability.[3] In 2016, the Global Burden of Disease project estimated the number of incident cases of stroke in India to be 1,175,778.[4] Another systematic review and meta-analysis on burden of stroke in India by Khurana et al revealed that the prevalence rate of stroke for total population, varied from 44.54 to 150/100000. The prevalence rate was 45 to 487/100000 for the urban population and 55 to 388.4/100000 for rural population. The estimated incidence rate varied from 33 to 123/100000 (urban population) and to 123.57/100000 (rural population) it was estimated. The 30 days case fatality rate of stroke varied from 41.08% to 42.06% in urban population and 18% to 46.3%.in the rural population. All these data indicate a high stroke burden in India. [5]

Stroke encompasses two major categories: Ischaemic stroke and Haemorrhagic stroke . It is difficult to distinguish between the two without more detailed investigation. Ischaemic stroke is the most common form. Of all strokes, 87% are ischemic, 10% are intracerebral haemorrhage, and 3% are subarachnoid haemorrhage strokes[6]. Stroke is also a leading cause of functional impairments, with 20% of survivors requiring institutional care after 3 months and 15% - 30% being permanently disabled.[7] Stroke is a life-changing event affecting not just the person but also their entire family or caregivers owing to the disability it causes. The Indian Global Burden of Disease Study 1990-2019, estimated that among all the disease the largest contributor to disability adjusted life years (DALYs) was stroke. Also Stroke serves as a chief contributor to mortality caused by neurological disorders.[8] An absolute increase in stroke deaths by 36.7% [95% UI, 26.3–48.5] among younger adults was observed in developing countries, compared to declining trends in developed countries.[9] Stroke in this age group tends to carry manifold social, physical, emotional, vocational, and economic connotations.[10] In India, nearly 20% of the patients with first ever strokes admitted to hospital are under the age of 40 years, and this frequently has a distressing impact on the future health, finances, and wellbeing of individuals and their families.[5] One-month case fatality rate following stroke varied from 18% to 42% in India[5] , which is higher than that observed in developed nations and was twice as high in men than women in comparison to higher premature case fatality rates in women, globally.

Most of the epidemiological data in India is only from the four cities of Mumbai, Trivandrum, Ludhiana, Kolkata. Hence there is a paucity of epidemiological data in the state of Andhra Pradesh especially in the region of North coastal Andhra regarding the prevalence, clinical presentation, and outcome of the stroke. Hence, we aimed to determine the clinical profile and outcome of stroke patients attending a tertiary care teaching hospital in North coastal Andhra with the objectives to determine the demographic characteristics and clinical presentation of stroke patients and to evaluate the various risk factors and outcomes associated with stroke.

Materials and methods

We conducted a prospective hospital-based study of 100 consecutive stroke cases admitted to Government General Hospital (GGH) Srikakulam during the study period. All cases admitted with stroke were diagnosed by history and clinical examination and were then confirmed by investigation including CT scan. All patients with focal (or at times global) neurological impairment of sudden onset, lasting more than 24 hours (or leading to death), and of presumed vascular origin were included in the study. Patients with Transient ischemic attack , Subdural haemorrhage , Epidural haemorrhage, head trauma, coma secondary to shock and hypertensive encephalopathy were excluded from the study.

Data collection

After admission, a detailed history regarding the temporal profile of the stroke and risk factors like hypertension, diabetes mellitus, smoking, alcohol, heart diseases, and previous stroke history were elicited and noted. Detailed neurological examination and cardiovascular examination was carried out in all patients. Computerised Tomography scan, 2D Echocardiography, Carotid colour Doppler study and ultrasound scan of abdomen were done in all cases. All basic biochemical parameters like lipid profile, blood sugar, blood urea, serum creatinine and electrolytes, and hemogram were done. Patients were then followed up to the time of discharge or death as the case may be. The data collected was organized into a Microsoft excel sheet and Statistical Package for Social Sciences (SPSS) software version – 26 was utilized for statistical analyses. Descriptive analyses were performed including frequencies (N), percentages (%), Mean, and Standard deviation (SD). Suitable statistical tests, such as the chi-square test and Pearson correlation test were applied to find the association between different variables. The level of significance was adopted at p-value < 0.05 for all statistical analyses.

Results

A Total of 100 stroke patients were studied. The demographic characteristics of the study population are given in the Table1. About 60 % (n=60) of the total participants were males and 40% (n=40)were females. Out of which 76 %(n=76) patients had ischaemic stroke and 24% (n=24) patients had haemorrhagic stroke. The highest occurrence of stroke was noted in the age group more than 60 years (32%). Of the total cases, about 14% (n=14) were stroke in young (Age <40years) with majority of them being ischemic strokes (10/14).

Table 1. Demographic characteristics of the patients in the present study

Variable	Frequency	Percentage
Gender		
Male	**60**	**60%**
Female	**40**	**40%**
Age group		
18-40years	**14**	**14%**

41-50 year	**26**	**26%**
51-60	**28**	**28%**
>60years	**32**	**32%**
Stroke type		
Ischemic	**76**	**76%**
Haemorrhagic	**24**	**24%**
Recurrent	**15**	**15%**
Risk factors for stroke		
Hypertension	61	61%
Diabetes mellitus	32	32%
Dyslipidaemia	34	34%
Smoking	42	42%
Alcohol	57	57%
Ischemic heart disease	9	9%
Past h/o Cerebrovascular accident	15	15%

Hypertension(61%), alcoholism (57%) and smoking (42%)were the most common risk factors for stroke in the present study. They were followed by Dyslipidemia(34%) and Diabetes Mellitus(32%) It is interesting to note that about half of the patients in the present were habituated to smoking and alcoholism.

Clinical presentation of the stroke : About two thirds of the patients (64%) presented to the hospital after 24 hours of the onset of symptoms. The clinical characteristics of the patients are given in the Table 2. As per the table 2, motor weakness in the form of hemiplegia/hemiparesis (74%) and impaired consciousness (56%)were most frequent presenting symptoms of the patients.

Table 2. Clinical characters of stroke in the present study

Clinical features	Ischemic (76%)	Haemorrhagic(24 %)	Total
Hemiplegia/Hemiparesis	60(79%)	14(58.4%)	74(74%)
Headache	22(29%)	8 (33%)	30(30%)
Vomiting	26(34.2%)	16(67%)	42(42%)
Impaired consciousness	36(47.3%)	20(84%)	56(56%)
Aphasia	23(30%)	3 (12.5%)	25(25%)
Vertigo	7 (9.3%)	2 (8.3%)	9 (9%)
GCS < 8	14(18.4%)	14(58.3%)	28(28%)
Atrial fibrillation	10(13.15%)	-	10%
Complications			
Aspiration pneumonia			28%
UTI			42%

Pressure sore			29%
Mortality	20 (26%)	16(66%)	36%

GCS – Glasgow coma scale, UTI- Urinary tract infection

Impaired consciousness (84% vs 47.3%) with low GCS (<8) (58.3% vs 18.4%) and vomiting (67% vs 34.2%) were more frequent in Haemorrhagic stroke than in Ischemic strokes. Urinary tract infection (UTI) (42%) was the most common complications in the present study population. High mortality was noted in haemorrhagic stroke (66% of the cases).

Radiological features of stroke: The Radiological characteristics of stroke among the study population is shown in the table 3. Most of the ischemic stroke patients had cortical or lobar infarcts (51.3%). Internal capsule was the next most frequent site of thrombus in Ischemic stroke patients. Lobar(33%) and capsuloganglionic areas(29%) were the most common site of intracerebral bleeding in the present study population. Out of the 100 patients in the study population, in 34(44.7%) of the total 76 ischaemic stroke patients and 4(16.7%) of the total 24 haemorrhagic patients showed carotid artery narrowing on the ultrasonography. In About 89.5% patients with carotid artery narrowing, stroke was observed to be consistent with the side of the narrowing. Electrocardiogram showed Atrial fibrillation in 10%(n=10)of the study population. Two-Dimensional Echocardiogram revealed that about 4%(n=4) patients had Mitral stenosis, 10% (n=10)patients were reported to have Aortic stenosis, 12%(n=12) patients had Mitral regurgitation and 20%(n=20) patients had Left ventricular dysfunction. About two thirds (68%, n=68) of the total patients had serum cholesterol above 200 mg/dl predominantly in ischemic stroke(n=52, 76.5%). Out of the 100 patients, 34 patients had serum High Density Lipoproteins Cholesterol (HDL-C) < 40 (24 were ischaemic strokes and 10 were haemorrhagic strokes). About 48 of the 100 patients had serum Low density lipoprotein (LDL) above 100 mg/dl.

Table 3 Radiological (Computerised tomography -CT) features of the study population.

Site of infarct/bleed	Ischemic	Haemorrhagic	Overall
Cortical/lobar	39(51.30%)	8(33%)	47%
Basal ganglia	4(5.25%)	7(29%)	
Internal capsule	14(18.40%)		25%
Insula	2(2.70%)	-	2%
Thalamic	6(7.90%)	4(16.80%)	10%
Cerebellar	5(6.60%)	1(4.20%)	6%
Pons	2(2.70%)	2(8.40%)	4%
Centrum semi ovale	4(5.25%)	-	4%
Others	-	2 (8.40%)	2%

As per the table 4, male patients with stroke were one and half times more likely to succumb to death than female patients with stroke(p<0.0001) Similarly, patients with haemorrhagic stroke were five times more prone for death compared to ischemic stroke. This association was statistically significant.(p=0.0007). Clinical features such as a GCS of less than 8 at admission (OR=80.6, p<0.0001), Haemorrhagic stroke with Intraventricular extension OR= 6.2, p=0.0311), with Midline shift (OR= 12, p=0.001) showed a statistically significant positive association with poor outcome in the form of death. Complications such as Aspiration pneumonia was statistically significant positive association with death among the stroke patients in the present study(OR=5.4, p=0.0004).

Table 4. Odds ratio of various variables of the study population with respect to the outcome.

Variable	Expired (n=36)	Survived (n=64)	Odds ratio	95%CI	z statistic	p
Gender						
Male	24	36	1.56	13.7919 to 331.3361	5.196	**< 0.0001***
Female	12	28				
Clinical features						
Hemorrhagic stroke	16	8	5.6	2.0799 to 15.0776	3.409	**0.0007***
Ischemic stroke	20	56				
GCS<8	26	2	80.6	16.5060 to 393.5749	5.425	**< 0.0001***
GCS>8	10	62				
High Blood pressure	26	42	1.36	0.5574 to 3.3274	0.678	0.4979
Without High blood pressure	10	22				
With IV extension of bleed	6	2	6.2	1.1805 to 32.5634	2.156	**0.0311***
Without IV extension of bleed	30	62				
With Midline shift	16	4	12	3.5895 to 40.1172	4.035	**0.0001***
Without midline shift	20	60				
With Aspiration pneumonia	18	10	5.4	2.1110 to 13.8132	3.519	**0.0004**
Without Aspiration pneumonia	18	54				

*p<0.05- statistically significant. GCS – Glasgow coma scale, IV – intraventricular

Discussion

When considered separately from other cardiovascular diseases, stroke ranks No. 5 among all causes of death, behind diseases of the heart and cancer[11]. Age is one of the powerful predictors of all types of strokes. In the present study, mortality was high (32%, n=32) in the elderly population with age above 60 years. These findings were comparable with other studies such as Yemeni study[12] and Mohan et al study from Bahrain[13]. Jones SP et al[3], in the systematic review of Stroke in India noted that, the mean age of those presented with stroke in India was 62.2 years. In the present study about 76%(n=76) of the patients had ischaemic stroke and 24% (n=24) of the patients had haemorrhagic stroke. Sridharan et al[14] had similar higher incidence of Ischaemic strokes compared to haemorrhagic strokes, whereas Das et al [15]reported higher incidences of intracerebral bleed. In a study done by Pandian et al [16]in Trivandrum, ischemic stroke accounted for 84% whereas intracerebral haemorrhage was noted in 11% of the cases. The overall sex disaggregated incidence rates were only slightly higher for males than females in patients with stroke in India[3] .Incidence of strokes in young was about 14% in the present study. Similar incidences were reported in Lausanne et al[17], Nagaraja et al [18]and S.Kaul et al.[19,20]Worldwide, the incidence of stroke in young is continuing to rise with around 2 million individuals in the age group of 18‑ 50 years experiencing stroke[21]. A delay of 24hrs was noted in the presentation to the hospital in the present study in about two thirds of the patients.

Different risk factors were recorded and analysed for their association with haemorrhagic and ischemic stroke. As already mentioned, elderly people are the most vulnerable group for developing stroke. Among the modifiable factors, Hypertension was the commonest risk factor seen in 61% of

the patients. Hypertension emerges as the most important and common risk factor in both haemorrhagic and ischemic stroke. This result correlates with that of Siddique et al study[22]. Whereas Ong et al and Sallam et al studies reported association of hypertension more with haemorrhagic stroke. Next to hypertension, the most frequent risk factor observed was usage of alcohol and tobacco. Similar findings were seen in Das et al[15] and Sallam et al[12]. Woon et al[23] reported that alcohol usage in excessive amounts is a major risk factor for stroke. Dyslipidaemia was also found to be a significant risk factor for stroke in the present study. Diabetes mellitus has long been recognized as a risk factor for vascular disease as well. In the present study, about 32% of the stroke patients had diabetes mellitus. Similar findings were observed in Sridharan et al [14] and Sallam et al[12] studies. Singla M et al [21] in their study of stroke in young found out that risk factors for stroke were hypertension (72%) followed by diabetes (23%), dyslipidemia (15%), and drug addiction (9%).

Thirteen patients of cerebral infarction and two cases of cerebral haemorrhage had previous history of stroke. Previous history of stroke was more frequently noted in ischemic strokes. Transient ischemic attack (TIA) is a major risk factor for disabling stroke, implying a 13-fold increased risk of stroke in the next l year as reported by Saxena et al[24]. Out of the 15 patients who suffered a stroke in the past, only 5 of them were adherent to the prescribed treatment. Rest of the patients were non-compliant to treatment. Among the 70% of the patients who had history of either hypertension or diabetes, only 34% were using treatment regularly. Non-compliance to treatment is one of the major risk factors for stroke. In the present study group, 44% of the patients presented with clear conscious sensorium. About 24% of the patients were unconscious and 32% in impaired sensorium at presentation. Out of 100 cases, 74 patients presented with complaints of hemiplegia. This result correlates with Siddique et al study[22] and Framingham study[25] where hemiplegia was found to be the commonest presentation. Next to focal signs the other common symptoms were dysphagia, loss of control over bowel and bladder, headache, vomiting, convulsions, speech disorders etc. Most of the presenting complaints were comparable to Siddique et al[22] from Chittagong. It is apparent from this study that headache and vomiting has got greater association with haemorrhagic stroke.

The commonest clinical sign in our study was weakness of the limbs. Hemiparesis was seen in more than 70% of the patients with cortical, thalamic, and basal ganglia lesions , while pontine lesions presented with quadriparesis. Second commonest clinical finding observed was seventh cranial nerve abnormality(36%). Various speech syndromes were seen in 30% of the patients. Abnormal eye signs were present in all the pontine strokes. A hemi sensory syndrome was seen in 14% of strokes. Most of them were thalamic strokes. As expected, patients with cerebellar strokes had abnormal neurological signs pointing to cerebellar dysfunction. Among the 28 patients whose GCS was 8 and below, 14(50%) were ischaemic strokes and 14(50%) were haemorrhagic strokes. Present study reported that 58.3% of haemorrhagic strokes had GCS below 8. These findings were very similar to Siddique et al study[22] from Chittagong.

The CT scan is the most important diagnostic tool for the diagnosis of stroke. As newer treatments such as thrombolytic therapy and surgical decompression for Intracerebral bleeds are being offered nowadays, role of CT scan is growing much bigger in the management of an acute stroke. The often-subtle unenhanced CT signs of early ischemia are parenchymal hypoattenuation with loss of gray matter-white matter differentiation owing to cytotoxic oedema ("insular ribbon" sign), sulcal effacement, due to oedema; and hyper attenuated vessels owing to intraluminal thrombus e.g., hyperdense MCA (Middle cerebral artery) sign. Gonzalez et al[26] came up with the revelation that in blinded review the sensitivity of unenhanced CT far exceeds that of conventional

T2-weighted and proton density-weighted Magnetic resonance imaging. In about half of the stroke patients (47%) in the present study , the CT scan revealed occurrence of the infarct/ bleed predominantly in the cortical lobes followed by capsuloganglionic area (25%) and thalamus (10%) (table 3). Most of the ischaemic strokes (51.3%) involved cortical areas. Following the cortex, areas involved were internal capsule, thalamus, basal ganglia. These findings were comparable to the study findings of Siddique et al.[22] In the present study, most of the haemorrhagic strokes (33%) involved cortical areas. Following the cortex, areas involved were basal ganglia, thalamus. These findings were consistent with the study done by Siddique et al[22]. Whereas Thacker et al[27] and Kase et al[28]reported that most of the haemorrhages involved basal ganglia. About 32 patients in the present study showed mass effect on the CT scan. Lateral shift of the midline structures was seen in 20 patients. About 10% of the patients had atrial fibrillation These results were comparable with Sridharan et al [14]who reported 8%. Most common complication observed in our study was urinary tract infection (42%) followed by pressure sores (29%) and Aspiration pneumonia(28%). Langhorne et al[29] reported aspiration pneumonia as more common complication in stroke patients.

Regarding the outcome in present study, the mortality rate was 36%. It is higher when compared to similar studies done by Sallam et al [12]and Bath et al[30] . Haemorrhagic strokes had higher mortality than that of ischemic stroke (66% vs 26%); like many previous studies. About 24 (40%) of 60 males and 12 (30%) of 40 females patients succumbed to death in our study. Males had one and half times more odds of having a poor outcome due to stroke than females. About 28 (28%)patients scored less than 8 on GCS and 26 (92%) of them expired and only 2 survived. The level of consciousness at admission is undoubtedly the most important factor determining the outcome. Three out of four patients with intra ventricular extension succumbed to death. Haemorrhagic strokes with intra ventricular extension, Mass effect and midline shift had significant associations with mortality. Mortality rates were very high and significant in patients whose course of illness was complicated by infections such as Urinary tract infections and Aspiration pneumonia.

Conclusion: Ischemic stroke (76%) was the most common type of stroke observed in the present study occurring frequently in elder population (>60 years) with a male preponderance. Hypertension was most common risk factor, followed by smoking and alcohol usage. Older age, male gender, low GCS score at presentation, haemorrhagic stroke with intra ventricular extension of bleed and mass effect with midline shift were strongly associated with the poor outcome of stroke. Non-compliance to treatment of hypertension and diabetes is one of the major risk factors for stroke. Hence it is crucial to manage risk factors and comorbidities adequately to prevent occurrence of stroke.

References

1. The World Health Organization MONICA Project (monitoring trends and determinants in cardiovascular disease): a major international collaboration. WHO MONICA Project Principal Investigators. J Clin Epidemiol. 1988;41(2):105-14. doi: 10.1016/0895-4356(88)90084-4. PMID: 3335877.

2. GBD 2019 Stroke Collaborators. Global, regional, ad national burden of stroke and its risk factors, 1990-2019: A systematic analysis for the global burden of disease study 2019. Lancet Neurol 2021;20:795-820.

3. Jones SP, Baqai K, Clegg A, et al. Stroke in India: A systematic review of the incidence, prevalence, and case fatality. International Journal of Stroke. 2022;17(2):132-140. doi:10.1177/17474930211027834

4. GBD 2016 Stroke Collaborators. Global, regional, and national burden of stroke, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol 2019; 48: 439–458. 10. Kamalakannan

5. Khurana S, Gourie-Devi M, Sharma S, Kushwaha S. Burden of Stroke in India During 1960 to 2018: A Systematic Review and Meta-Analysis of Community Based Surveys. Neurol India. 2021 May-Jun;69(3):547-559. doi: 10.4103/0028-3886.317240. PMID: 34169841.

6. Virani, S.S.; Alonso, A.; Benjamin, E.J.; Bittencourt, M.S.; Callaway, C.W.; Carson, A.P.; Chamberlain, A.M.; Chang, A.R.; Cheng, S.; Delling, F.N.; et al. Heart Disease and Stroke Statistics-2020 Update: A Report from the American Heart Association. Circulation 2020, 141, e139–e596.

7. Lloyd-Jones D, Adams RJ, Brown TM, Carnethon M, Dai S, De Simone G, Ferguson TB et al, J. Heart disease and stroke statistics—2010 update: a report from the American Heart Association. Circulation. 2010; 121:e46–e215.

8. India State-Level Disease Burden Initiative Neurological Disorders Collaborators. The burden of neurological disorders across the states of India: The Global Burden of Disease Study 1990-2019. Lancet Glob Health 2021;9:e1129-44.

9. Feigin VL, Norrving B, Mensah GA. Global burden of stroke. Circ Res 2017;120:439-48

10. Maaijwee NAMM, Rutten-Jacobs LCA, Schaapsmeerders P, van Dijk EJ, de Leeuw F-E. Ischaemic stroke in young adults: Risk factors and long-term consequences. Nat Rev Neurol 2014;10:315-25.

11. Tsao, C. W., Aday, A. W., Almarzooq, Z. I., Anderson, C. A. M., Arora, P., Avery, et al. (2023). Heart disease and stroke Statistics—2023 update: A report from the American Heart Association. Circulation, 147(8). https://doi.org/10.1161/cir.0000000000001123

12. Abdul-Rahman Sallam, Khalid Al- Aghbari, Hesham Awn The Clinical Profile of Stroke: A Yemeni Experience. J Med J 2009; Vol. 43 (2):115-121.

13. Pochiraju K. Mohan, DM, Adel A. Al-Jishi, FRCPI, Profile of stroke in Bahrain Neurosiences 2000; Vol. 5 (1): 30-34

14. Sridharan S et al. Incidence, types, risk factors and outcome of stroke in a developing country: the Trivadrum Stroke Registry. Stroke 2009; 40: 1212-18

15. Das SK, Banerjee TK, Biswas A, et al. A prospective community-based study of stroke in Kolkata, India. Stroke 2007; 38: 906–910

16. Pandian JD, Singh G, Kaur P, et al. Incidence, shortterm outcome, and spatial distribution of stroke patients in Ludhiana, India. Neurology 2016; 86: 425–433

17. J Bogousslavsky, G Van Melle and F Regli.The Lausanne Stroke Registry: analysis of 1,000 consecutive patients with first stroke. Stroke. 1988;19:1083-1092.

18. Nagaraja D, Christopher R, Manjari T. Anticardiolipin antibodies in ischemic stroke in the young: indian experience. Journal of the Neurological Sciences. 1997

19. Kaul S, Venketshwamy P. Frequency,clinical features and risk factors of lacunar infarction. Neurol India 2000;48(2):116-19

20. Kaul S et al, Stroke burden and risk factors in developing countries with special reference to India. JIMA 2009 Jun;107(6):358, 367-70.

21. Singla M, Singh G, Kaur P, Pandian JD. Epidemiology of young stroke in the Ludhiana population-based stroke registry. Ann Indian Acad Neurol 2021;25:114-9

22. Md. Abu Naser Siddique et al clinical presentation and epidemiology of stroke –A study of 100 stroke cases.J MEDICINE 2009; 10 : 86-89

23. Jae Woong Sull, Sang-Wook Yi, Chung Mo Nam and Heechoul Ohrr. A Kangwaha cohort study. Stroke 2009, 40:2953-2958.

24. Saxena R. Prevention of early recurrences in acute stroke. In: Bogousslavsky J, ed. Acute stroke treatment. London: Taylor & Francis, 2003: 283-293.

25. Gresham GE, Fitzpatric TE, Wolf PA .Residual disability in survivors of stroke-The Framingham study.N Engl J Med 1975:293:454-56.

26. R.G. Gonzalez, J.A. Hirsch, W.J. Koroshetz, M.H. Lev, and P. Schaefer, Acute Ischemic Stroke: Imaging and Intervention. AJNR Am J Neuroradiol. 2007 Sep;28(8):1622–3. doi: 10.3174/ajnr.A0628. PMCID: PMC8134372.

27. A.K. Thacker et al clinical and CT analysis of ICH; JAPI vol 39 april 1991;317-319.

28. Kase et al lobar intracerebral haemorrhage-clinical and CT analysis of 22 cases. Neurology 1982; 32;1146-50

29. Langhorne et al Medical Complications After Stroke : A Multicenter Study.
Stroke 2000, 31:1223-1229

30. Bath P, Lees K. ABC of arterial and venous disease. Acute stroke BMJ 2000;320:920-923