

A Study of Etiological Profile of Stroke in Young Adults

Dr. T. Sateesh Kumar¹, Dr. E. Sailaja²

1. Assistant Professor, Department of Neurology, Andhra Medical College, Visakhapatnam.

2. Senior Resident, Department of Neurology, Andhra Medical College, Visakhapatnam.

Abstract

Background

Stroke is the second commonest cause of death and fourth leading cause of disability worldwide. Genetic causes may be underlying stroke more frequently in the young than do in the elderly patients, indicating a need for genetic counseling. To the best of our knowledge, the present study is the largest study of stroke in young patients from North coastal Andhra Pradesh.

Materials And Methods

This was a prospective, descriptive study evaluating 107 patients diagnosed to have stroke in the age group of 15-45 years admitted to King George Hospital, Visakhapatnam from December 2010 to December 2012. The patients were divided into 3 groups, 15-24, 25-34 yrs and 35-45 years of age, to study the risk factors, etiological profile, ischemic stroke subtypes in these subgroups.

Results

Majority of patients in present study were seen in 35-45 age group (51%) followed by 15-24 age group (27%) and then 25-34 age group (22%). Mean (\pm SD) age of presentation was 32.54 (\pm 9.56) years. Overall in the study population females were relatively younger. Smoking (37%) was the most prevalent risk factor, followed by hypertension (35%), alcoholism (22%), cardiac disorders (13%) and dyslipidemia (10%). 91% of total strokes were ischemic and only 9% of pts had hemorrhagic stroke. Arterial strokes (90%) were more common than venous strokes. Most of arterial strokes involved anterior circulation (76%). Based on the TOAST criteria, An etiological categorization of ischemic stroke was obtained in 76 pts (78%) and it was uncertain or unknown in rest (21pts 22%). There were 19% patients with Large vessel atherosclerosis, 14% patients small vessel occlusion, 13% patients with cardio embolic stroke, 32% strokes were adjudicated as of other determined aetiology. Rheumatic heart disease (9pts) was most common abnormality in cardioembolic stroke. OSASD was seen in two pts. MVP, PFO with ASA was seen in one pt each. TBM accounted for stroke in six pts. Hyperhomocystinemia was seen in four pts. Takayasu arteritis was seen in three pts. Nephrotic syndrome, HIV, anti-thrombin-III deficiency in two pts each. Coarctation of aorta, Sick cell disease were seen in one pt each. Pregnancy related problems (including postpartum) contributes stroke in six patients. Hypertension is most common etiological factor in ICH followed by eclampsia, ruptured aneurysm and moyamoya disease. ECHO was abnormal in 36% patients. Left ventricular hypertrophy was most common abnormality followed by rheumatic heart disease. Carotid artery stenosis of more than 70% was noted in 22 patients on neck vessel doppler. CT/MR angiogram was done in only 55 patients. Arteriographic abnormalities were noted in 15 patients- focal stenosis (4), occlusion (5), arteritis (3), moyamoya pattern (1), aneurysm rupture (2). Venogram was done in 9 patients. Most commonly involved sinuses in venous stroke were transverse sinus, sigmoid sinuses followed by superior sagittal sinus.

Conclusions

Our findings contribute to the understanding of the spectrum of risk factors and etiological profile of stroke in young adults. A rigorous search for all potential risk factors is obviously crucial for adequate secondary prevention.

Date of Submission: 11-11-2019

Date of Acceptance: 27-11-2019

ABBREVIATIONS: LAA-- Large artery atherosclerosis; SVO--Small vessel occlusive disease ; CE-- Cardioembolism; ODE --Other determined etiology; UDE--Undetermined etiology; NM--Not mentioned; TOAST--Trial of ORG 10172 in Acute Stroke Treatment; RHD--Rheumatic heart disease; PFO--Patent foramen ovale; MVP-- Mitral valve prolapsed; ICH-- Intracerebral hemorrhage; SAH--Subarachnoid hemorrhage; CVT--Cortical venous sinus thrombosis; MS--Mitral Stenosis; MR--Mitral Regurgitation; AS--Aortic Stenosis; TBM--Tubercular meningitis; SLE--Systemic lupus erythematosus; COA--Coarctation of Aorta; ACOM --Anterior Communicating Artery; M--Magnetisation Transfer; TEE -- Transoesophageal Echocardiogram; TCD--Trans Cranial Doppler; ECG--Electrocardiogram; TTE-- Transthoracic echocardiogram; Sm--Smith; APTT--Activated partial thromboplastin time; MRA--MR

angiography; CADASIL--Cerebral autosomal dominant arteriopathy with subcortical infarcts and leucoencephalopathy; HANAC--Hereditary angiopathy, Nephropathy, Aneurysm, and Muscle cramps; GLA-- α -galactosidase; MELAS--Mitochondrial encephalopathy with lactic acidosis and stroke-like episodes; ENA -- Extractable nuclear antigens; ANCA--Antineutrophil cytoplasmic antibodies;

I. Introduction

Stroke is the second commonest cause of death and fourth leading cause of disability worldwide¹. Although stroke is considered to be a disease of the older population, it is not infrequent among adolescents and young adults²⁻⁴. More than two-thirds of the global burden of stroke is borne by developing countries, where the average age of patients with stroke is 15 years younger than in developed countries. The spectrum of underlying causes and risk factors in young individuals differs significantly from their older counterparts. Young stroke patients are at their most productive age and usually have under-aged children at their custody. So impact of stroke on the individual, family and society is strongest when it affects a young individual. They may have a longer period of time to live with their disability, and this may contribute to a lifetime of medical complications. The lost productivity of a young working person may account for costs associated with stroke exceeding the costs of stroke in an older person. Genetic causes may be underlying stroke more frequently in the young than do in the elderly patients, indicating a need for genetic counseling. Efficient acute treatment and prevention of stroke in a young adult increases number of quality-weighted life years much more than in elderly patients. There are very few studies from India especially from Andhra Pradesh on stroke in young patients from a tertiary referral center^{9,10,12,18} and most of these have involved ischemic stroke, conducted before the widespread use of modern neuroimaging methods; thus, with few exceptions^{7,9,12} they did not identify stroke subtypes, etiopathogenesis, and long term outcome. To the best of our knowledge, the present study is the largest study of stroke in young patients from North coastal Andhra Pradesh. We evaluated all young stroke patients admitted to the King George Hospital, Visakhapatnam, for risk factors, etiology and stroke subtypes

II. Materials And Methods

This was a prospective, descriptive study conducted in the Department of Neurology, King George Hospital, Visakhapatnam, tertiary care government general hospital receiving patients from North coastal Andhra Pradesh and neighbouring districts of Orissa.

All patients aged 15-45 years with the diagnosis of stroke (both ischemic and hemorrhagic) admitted in the study centre during December 2010 to December 2012 were recruited. Patients with head trauma, subdural or epidural hematoma, cerebral tumour and transient ischaemic attack were excluded.

Stroke was defined as "a focal (or at times global) neurological impairment of sudden onset, and lasting more than 24 hours (or leading to death) and of presumed vascular origin". Hypertension (HT) was defined as being present when (1) the patient was previously diagnosed with HT by a clinician or (2) systolic blood pressure was ≥ 140 mm Hg and/or diastolic blood pressure was ≥ 90 mm Hg on 2 different occasions measured at least 2 weeks after the acute stage depending on the severity of the stroke. Diabetes mellitus was defined when fasting blood glucose > 126 mg/dl and/or history of previous oral anti-diabetic or insulin use. Dyslipidemia as the fasting blood cholesterol ≥ 200 mg/dl and/or triglyceride level of 150 mg/dl, HDL < 40 mg/dl for men or < 50 mg/dl for women. Cigarette smoking as a risk factor when a patient has smoked 10 cigarettes per day for more than 1 year before stroke. Alcohol consumption as a risk factor when a patient has regularly drunk alcohol at an amount of 30 g per day or more for at least 1 year before stroke. Mitral valve prolapse was diagnosed on the basis of published criteria for M-mode and two-dimensional echocardiographic image. Stroke was attributed to oral contraceptives if the woman was using them at the time of the cerebral infarction in the absence of other identifiable causes. A coagulation defect was defined as prolonged prothrombin, partial thromboplastin, or bleeding times. Criteria for migrainous stroke included a well established history of migraine, a typical migraine headache at the time of the acute stroke, and the absence of other identifiable causes for the stroke. General physical examination and neurological examination of each patient was performed as per proforma. All patients had CT scan or MRI of brain, complete blood count, complete urine examination, prothrombin, partial thromboplastin and bleeding times, blood glucose, serum electrolytes, lipid profile, chest roentgenogram, ECG, Transthoracic echocardiogram, Duplex scanning of cervicocephalic vessels. Complementary investigations were done in selected patients with abnormal findings on initial evaluation as indicated e.g. Cerebral angiography, CSF analysis, anti cardiolipin antibodies, anti nuclear and other auto antibodies (ANCA, Anti-SSA, Anti-SSB, RA Factor), Protein C and S, AT III levels, activated protein C resistance, Hb electrophoresis and sickle cell testing, serum homocysteine, HIV serology, serological tests for syphilis, Factor V Leiden mutation, Lipoprotein A level. Risk factors, subtype of stroke (according to TOAST criteria) and etiology of stroke were assessed according to clinical & laboratory data. Stroke was classified as SAH, ICH or Cerebral infarction based on neuroimaging findings. Ischemic stroke events were further classified according to the TOAST (Trial of Org 10172 in Acute Stroke Treatment) classification. The categories were: 1.

Large-vessel atherosclerosis: Atherosclerosis with stenosis.2. Small-vessel disease: Lacunar syndrome and normal CT/MRI or relevant lesion <1.5cm and absent source of emboli.3. Cardioembolism.4. Other determined causes.5. Undetermined causes: Two or more causes identified, Negative evaluation, Incomplete evaluation. Arterial territory of stroke was classified according to imaging findings or clinical signs. We divided the patients into 3 groups, 15-24, 25-34 yrs and 35-45 years of age, to study the risk factors, etiological profile, ischemic stroke subtypes in these subgroups. Statistical analysis was performed using chi-square test for categorical variables. Significance was set at $p < 0.05$.

III. Results

The Present study evaluated 107 patients diagnosed to have stroke in the age group of 15-45 years admitted to King George Hospital, Visakhapatnam from December 2010 to December 2012 fulfilling inclusion and exclusion criteria. Majority of patients in present study were seen in 35-45 age group (51%) followed by 15-24 age group (27%) and then 25-34 age group (22%). Mean (\pm SD) age of presentation was 32.54 (\pm 9.56) yrs in the study population. Males (64 pts-60%) outnumbered females (43pts-40%) in this study with male: female ratio of 1.5:1. Patients aged below 24 were more commonly females (20%). Males were more in the age group of 35-45 (42%) with a significant P value. Mean age of presentation for males was 35.46 \pm 8.73 yrs and for females was 28.18 \pm 9.15 yrs. Overall in the study population females were relatively younger.

AGE & GENDER DISTRIBUTION

AGE(YRS)	MALES(PERCENTAGE)	FEMALES(PERCENTAGE)	P-value
15-24	9(8%)	20(19%)	0.0411
25-34	13(12%)	11(10%)	0.6831
35-45	42(40%)	12(11%)	0.0001
TOTAL	64	43	0.0423

Well documented vascular risk factors were more common in our study population. Hypertension, diabetes, dyslipidemia was present in 37 (35%), 7 (7%), 11 (10%) pts respectively. Among males 41 smoked more than 10 cigarettes or bidis per day and 24 were moderate to heavy drinkers of alcohol. None of the women in this study smoked or consumed alcohol or on oral contraceptive pills. Cardiac abnormalities were seen in 14pts (13%). H/O Migraine was noted in 5 patients. All of them were females. Previous history of stroke was present in 8 (7%) pts, transient ischemic attacks preceding the stroke occurred in 4 (4%) pts. A family history of stroke was seen in 2 (2%) pts. Hypertension, diabetes, dyslipidemia, smoking and alcoholism were more common in older age group (35-45yrs) with significant P values.

DISTRIBUTION OF RISK FACTORS ACCORDING TO AGE GROUP

RISKFACTOR	15-24YRS	25-34YRS	35-45YRS	Chi-square	P-value
HYPERTENSION	1	4	32	47.405	0.0001
DIABETES	1	-	6	3.571	0.0588
DYSLIPIDEMIA	-	-	11		
SMOKING	-	8	33	15.244	0.0001
ALCOHOLISM	-	6	18	6.000	0.0143
CARDIAC	4	5	5	0.615	0.9311
H/O TIA	1	1	2.	0.500	0.7788
PAST H/O STROKE	2	2	6	3.200	0.2019
FAMILY H/O STROKE	-	-	2		
H/O MIGRAINE	1	-	4	1.800	0.1797

DISTRIBUTION OF RISK FACTORS –ACCORDING TO SEX

RISKFACTOR	MALE	FEMALE	P-value
HYPERTENSION	29	8	0.0006
DIABETES	3	4	0.7055
DYSLIPIDEMIA	10	1	0.0067
SMOKING	41	-	
ALCOHOLISM	24	-	
CARDIAC	11	3	0.0325
H/O TIA	3	1	0.3173
PAST H/O STROKE	3	5	0.4795
FAMILY H/O STROKE	2	-	
H/O MIGRAINE	-	5	

91% (97 patients) of total strokes were ischemic and only 9% (10 patients) of pts had hemorrhagic stroke. Arterial strokes (90%) were more common than venous strokes in the present study. Most of arterial strokes involved anterior circulation (76%) and 23% patients had posterior circulation strokes. Based on the

TOAST criteria, An etiological categorization of ischemic stroke was obtained in 76 pts (78%) and it was uncertain or unknown in rest (21pts 22%). There were 18 (19%) patients with Large vessel atherosclerosis, 14 (14%) patients small vessel occlusion (lacunar stroke), 13 (13%) patients with cardioembolic stroke, 32 (32%) strokes were adjudicated as of other determined etiology.

ISCHEMIC STROKE-SUBTYPES

TYPE OF STROKE	NO.OF PTS	PERCENTAGE
LVA	18	19%
SVO	14	14%
CE	13	13%
ODE	31	32%
UDE	21	22%
TOTAL	97	100%

Large vessel atherosclerosis, small vessel occlusion and stroke of undetermined etiology were more common in older age group (35-45yrs) with significant P value for LVA and SVO. Stroke of other determined etiology was more in younger age group (15-24yrs) with a statistically significant p-value.

DISTRIBUTION OF ISCHEMIC STROKE SUBTYPES ACCORDING TO AGE GROUP

TYPE OF STROKE	15-24 YRS	25-34 YRS	35-45 YRS	MEAN AGE	CHISQUARE	P-value
LVA	-	5	13	38±6	3.556	0.0593
SVO	1	1	12	40±5	17.286	0.0002
CE	3	5	5	31±11	0.615	0.7351
ODE	17	6	8	28± 9	6.645	0.0361
UDE	6	4	11	33±10	3.714	0.1561

Large vessel atherosclerosis, small vessel occlusion and stroke of undetermined etiology were more common in males with a significant P-value for LVA andSAO and trend towards significance in stroke of undetermined etiology. Stroke of other determined etiology was more in females but statistically not significant. Rheumatic heart disease (9pts) was most common abnormality in cardioembolic stroke. OSASD was seen in two pts. MVP, PFO with ASA was seen in one pt each. TBM accounted for stroke in six pts. Hyperhomocystinemia was seen in four pts. Takayasu arteritis was seen in three pts. Nephrotic syndrome, HIV, antithrombin-III deficiency in two pts each. Coarctation of aorta, Sickle cell disease were seen in one pt each. Pregnancy related problems (including postpartum) contributes stroke in six patients. Hemorrhagic stroke was seen in 9 patients with male:female ratio 1:1.5. Mean age of presentation was 32.11 ± 9.8yrs. Hypertension is most common etiological factor in ICH followed by eclampsia, ruptured aneurysm and moyamoya disease. Puerperal sinovenous occlusion was seen in four pts. Nephrotic syndrome was a contributing risk factor for CVT in two pts.

SPECIFIC ETIOLOGIES IN OTHER DETERMINED CAUSES

ETIOLOGY	NO.OF PTS	PERCENTAGE
INFECTIONS	9	29%
TBM	6	19%
HIV	2	6%
OTHER BACTERIAL	1	3%
HYPERHOMOCYSTEINEMIA	4	13%
ANTITHROMBIN-III DEFICIENCY	2	6%
SICKLE CELL DISEASE	1	3%
SLE	3	10%
TAKAYASUS	3	10%
PREGNANCY RELATED	6	19%
COARCTATION OF AORTA	1	3%
NEPHROTIC SYNDROME	2	6%

INTRACRANIAL HEMORRHAGE IN YOUNG ADULTS

CHARACTERS	NO.OF PTS(10,M:F-4:6)
HYPERTENSION	5(ONE PT-ADPKD)-
ECLAMPSIA	2
ACOM ANEURYSM RUPTURE	1
MYCOTIC ANEURYSM RUPTURE	1
MOYAMOYA	1

DISCUSSION

Our hospital is a tertiary care government general hospital in north coastal Andhra Pradesh. Most of our cases are from rural areas around Visakhapatnam city. Our data should prove useful, for the diagnosis and management of young stroke patients in this part of the world.

AGE & GENDER DISTRIBUTION

Majority of patients in the present study were seen in 35-45 age group (51%) followed by in 15-24 age group (27%) then in 25-34 age group (22%). Mean (\pm SD) age of presentation was 32.54 (\pm 9.56) yrs in the study population which were comparable with study done by Mehndiratta et al²⁴, Bevan et al¹⁵, Owolabi et al²⁵. Most of our cases were in the 35-45 yrs age range corroborates the general observation that the incidence increases with age and age being the most powerful independent predictor of cardiovascular and cerebrovascular morbidity and mortality.

Males (64 pts-60%) outnumbered females (43 pts-40%) in this study with male: female ratio of 1.5:1. This is in accordance with other studies from India^{9,12,18} and abroad, Bevan et al¹⁵, Owolabi et al²⁵. The preponderance of stroke in young males in studies from developing countries, including ours, may largely be ascribed to a referral bias or may be due to differences in certain risk factors such as smoking, which is much more prevalent among men in India compared with women.

Patients aged below 24 were more commonly females (19%). Males were more in the age group of 35-45 (40%). Mean age of presentation for males was 35.46 \pm 8.73 yrs and for females was 28.18 \pm 9.15 yrs. Overall in the study population females were relatively younger. This was in accordance with study done by Putaala et al²⁶, Bevan et al¹⁵, Bogousslavsky J et al¹⁷, Cerrato et al²⁷.

RISK FACTORS

Regarding risk factors, as previously reported by other studies current smoking (37%) was the most prevalent risk factor, followed by hypertension (35%), alcoholism (22%), cardiac disorders (13%) and dyslipidemia (10%). The Framingham Heart Study was among the first to assess the relation of smoking to type of stroke, number of cigarettes smoked, and the effect of stopping. It concluded that smoking made a significant independent contribution to the risk of stroke generally and to brain infarction specifically. Regarding hypertension Framingham studies has shown that hypertension is a clear risk factor for stroke in both sexes and in all ages and races. Previous history of stroke was present in 7%, Transient Ischemic Attacks preceding the stroke occurred in 4%. A family history of stroke was seen in 2% patients. H/O Migraine headache was noted in 5% of patients. These were in comparison with the studies mentioned below. Dyslipidemia was less in our study population compared to other studies.

None of the women in this study smoked or consumed alcohol or on oral contraceptive pills. There was no patient with illicit drug use in our study in contrast to studies from developed countries (Bevan¹⁵ et al). Hypertension, diabetes, dyslipidemia, smoking and alcoholism were more common in older age group (35-45 yrs) and in males.

The accumulation of traditional risk factors in males and with aging is likely to explain the male predominance among older patients. The unexpectedly high frequency of modifiable risk factors indicate a need for aggressive primary and secondary prevention strategies.

Majority of the patients (34.57%) had multiple (two or more) risk factors in the present study. It is worthy of note that in 16.82% of the patients recruited no risk factors were detected. This category of patients should, however, be viewed from the perspective of the limited resources for in-depth evaluation. These findings were similar to study by Mehndiratta et al²⁴ and Owolabi et al²⁵.

INVESTIGATIONS

ECHO was abnormal in 38 (36%) patients. Left ventricular hypertrophy was most common abnormality followed by rheumatic heart disease these results were in accordance with study done by Nayak et al¹⁸. In the study population neck vessel Doppler was done in all patients and it was abnormal (carotid artery stenosis more than 70%) in 22 patients.

CT/MR angiogram was done in only in 55 patients and it was abnormal in 24 patients these results were in accordance with study done by Mehndiratta et al²⁴.

Arteriographic abnormalities were noted in 15 patients. Most commonly encountered abnormalities were focal stenosis (4), occlusion (5), arteritis (3), moyamoya pattern (1), aneurysm rupture (2). Most commonly involved vessel infarct stenosis or occlusion were ICA followed by MCA, ACA, Vertebral artery. None of our patients underwent DSA.

Venogram was done in 9 patients of 55 pts. Most commonly involved sinuses in venous stroke were transverse sinus, sigmoid sinuses followed by superior sagittal sinus.

STROKE SUBTYPES

In the present study, 91% (97 patients) of total strokes were ischemic and hemorrhagic strokes were observed in 9% (10 patients). These results were in accordance with studies done by Mehndiratta et al²⁴ (14.2%) and Gulcin, Benbir, Derya, Uluduz et al³⁴ (11.4%), Owolabi et al²⁵.

In our study 90% of ischemic strokes were arterial strokes and venous strokes constitute only 10%. Venous strokes constitute 0.6% to 27% of ischemic strokes in various studies done in India and abroad. (Nayak et al¹⁸-0.6%, Bansal⁸-27%, Chopra⁹-22.5%, Dalal¹³-7%, Bogousslavsky¹⁷ (Switzerland)-5%, Lanzino³² (Italy)-3%.

STROKE DISTRIBUTION: Most of arterial strokes involved anterior circulation (76%) and 23% patients had posterior circulation strokes in our study. This type of stroke distribution was also observed in studies done by Mehndiratta et al²⁴, Bogousslavsky et al¹⁷ and K Nedeltchev et al³⁰.

ISCHEMIC STROKE SUBTYPES

Based on the TOAST criteria, an etiological categorization of ischemic stroke was obtained in 76 pts (77%) and it was uncertain/unknown in rest (21 pts-23%). Stroke of other determined etiology was the most common ischemic stroke subtype and it accounts for 32% of ischemic strokes followed by stroke of undetermined etiology (22%), large vessel atherosclerosis (19%), small vessel occlusion (lacunar stroke) (14%), cardioembolic stroke (13%). This type of ischemic stroke subtype distribution was seen in most of the studies. But in none of these studies had stroke of other determined etiology as the most common ischemic stroke subtype. In majority of the studies stroke due to undetermined etiology was the most common ischemic stroke subtype followed by large vessel atherosclerosis and cardioembolic strokes.

Interestingly, our case series had a high frequency of uncommon causes of ischemic stroke in young patients. Therefore we suggest a high index of suspicion in young stroke patients in whom there is no apparent cause or risk factor responsible for stroke. Large vessel atherosclerosis, small vessel occlusion and stroke of undetermined etiology were more common in older age group (35-45 yrs) and males. Stroke of other determined etiology was more in younger age group (15-24 yrs) and females. These findings were in accordance with the studies done by Putaala et al²⁶, Larrue et al²⁷, Lee et al²⁷, Cerrato et al²⁹ and Nayak et al¹⁸.

LARGE VESSEL ATHEROSCLEROSIS

Premature cerebral atherosclerosis is generally the result of risk factors for cerebrovascular disease such as hypertension, diabetes mellitus, hyperlipidemia, and cigarette smoking. We found that 18% of the young patients with cerebral infarction had an atherosclerotic cause; the majority of these were >35 years old. Our experience is similar to that in other studies by Bevan et al¹⁵, Adams jr et al⁴.

CARDIOEMBOLIC STROKE

Cardioembolic stroke constitutes 13% of cases in ischemic stroke. This is in accordance with study done by Chopra et al⁹ (15%), Bansal et al⁸ (17%), Nayak et al¹⁸ (17%), and majority of studies from abroad (3-33.1%) but in majority of studies from India the percentage is relatively more (15-42%)²⁴. This reduced incidence in present study was probably due to reduced incidence of rheumatic heart disease now a days. Rheumatic heart disease contributed to stroke in 9 of these patients (69%), ASD in 2 cases (15%). Other cardiac conditions contributing to the risk of stroke in our patients included infective endocarditis (1), MVP (1), PFO with ASA (1). These proportions were in accordance with majority of studies from India. The frequency of mitral valve prolapse was low (1%) among our patients compared to 8%-29% in previously published studies. Only one patient had a patent foramen ovale in our study. Since none of our patients had undergone transoesophageal echocardiography (TEE), the diagnosis could have been missed in some of these patients. Infective endocarditis is one of the important causes of embolic stroke in young patients. Kumar et al³⁴. and Choudhary et al. reported stroke in 43% and 77.5% respectively of infective endocarditis cases with neurological deficits. In our study, 1 patient out of 13 with cardioembolic stroke had infective endocarditis.

STROKE OF OTHER DETERMINED AETIOLOGY:

Every third patient suffered from a stroke of other determined aetiology according to the TOAST classification in our study (32%). We identified 11 different aetiologies within this stroke category. Tubercular arteritis (six pts) and pregnancy related causes (six pts) being the most frequent accounted for 19% of cases each in this category. Hyperhomocystinemia was seen in four pts (13%). Lupus vasculitis and Takayasu arteritis in three pts (10%), Nephrotic syndrome, HIV infection, antithrombin-III deficiency in two pts each (6%). Coarctation of aorta, sickle cell disease were seen in one pt each (3%). Tubercular arteritis and pregnancy related

causes were more in studies done in India but cervical arterial dissection was the most frequent cause in stroke of other determined etiology in studies from abroad. We did not encounter any patient with dissection of the neck or cranial vessels this is in accordance to studies done in India^{24,18} whereas in other studies, it occurred in 0.3% to 22%^{17,26,32}. However, only 40% of our patients underwent angiography and hence we could have missed some of these lesions. Srinivasan et al⁷ reported meningo-vascular syphilis as an important risk factor for strokes in young in South India but our study did not find a single case of meningo-vascular syphilis causing stroke in young patients. This is expected, as neurosyphilis is much rarer nowadays as compared to the early 1980s. Migraine-related stroke occurred in none of our patients. Other studies have also shown a low incidence of migrainous stroke (1.2%-4.9%). In contrast, Bogousslavsky¹⁷ and Regli found a high incidence (14.6%) of migrainous strokes in patients under 30 years of age. Nagaraja et al³⁵ in their study found that 23% of the young stroke patients had positive anticardiolipin antibodies. But none of our patients had positive anticardiolipin antibodies (Anticardiolipin antibodies were done in four pts only). Inherited deficiency of coagulation inhibitors was seen in two patients (AT-III deficiency) in our study (Testing was done in six pts). The incidence was low in studies done by Kristensen³⁶ and Adams et al⁴ in 1995. But in majority of studies the incidence is more.

Puerperal sinovenous occlusion was seen in four pts in our study. Nayak et al¹⁸ encountered only one case of puerperal sinovenous occlusion. But this was strikingly different from the experience of other studies from India. Srinivasan⁷ has reported a 20% incidence while Chopra et al⁹ found it to be present in 16% of strokes in young. This reduced incidence was probably due to improved antenatal, natal, postnatal care.

CRYPTOGENIC STROKE:

The aetiology of stroke could not be determined in 22% of our patients. While this could be because many of our patients were incompletely investigated, the aetiology of stroke in the young adult has remained undetermined despite extensive investigations in 4%-45% of patients in other studies as well.

HEMORRHAGIC STROKE

In cases of ICH, the majority of patients had ruptured aneurysm, arteriovenous malformation, or hypertension and eclampsia as etiology in studies by Bevan et al¹⁵, Mehndiratta et al²⁴, and Dalalet al¹². In our study hypertension was major cause followed by eclampsia, ruptured aneurysm and moyamoya disease. One patient had alcohol addiction, no patient had illicit drug use in hemorrhagic stroke patients in accordance with study by Mehndiratta et al²⁴. While Bevan et al¹⁵ reported a high frequency of alcohol addiction (28.26% of cases) and illicit drug use (4.34% of cases) in ICH patients.

LIMITATIONS OF THE STUDY

The main limitation seems to be the relatively small number of patients recruited in this study. Ours being a tertiary care hospital so there was chance of referral and selection bias. Some of our patients were incompletely studied due to lack of certain facilities and financial constraints.

IV. Conclusions

Our findings contribute to the understanding of the spectrum of risk factors and etiological profile of stroke in young adults. Modifiable risk factors were common in young stroke patients and they tend to accumulate in males and along with ageing. A rigorous search for all potential risk factors is obviously crucial for adequate secondary prevention. Based on our data, we feel that the cause for stroke can be identified in a majority of young patients. Our study suggests that certain etiologies previously thought to be rare, need to be considered in cases of cerebral infarction in young patients in this part of the world. Hence, it would be worthwhile to investigate these patients to identify the cause. Stroke in young still poses a diagnostic challenge in about 22% of our patients, who also pose a therapeutic dilemma, since the exact cause of stroke could not be discerned.

Bibliography

- [1]. Strong K, Mathers C, Bonita R. Preventing stroke saves lives around the World *Lancet Neurol* 2007; 6: 182-7.
- [2]. Fratiglioni L, Wayne ME, Schoenberg DG et al: Mortality from Cerebrovascular Disease. *International Comparisons and Temporal Trends. Neuropidemiology*, 1983; 2: 101-6
- [3]. Kurtzke JF: In: McDowell FH et al. (eds.) *Cerebrovascular Survey Report NINCDS/NIH Publ. Health Services USA*, 1985; 1-34
- [4]. Adams HP Jr, Kappelle LJ, Biller J et al: M. Ischemic stroke in young adults. Experience in 329 patients enrolled in the Iowa Registry of stroke in young Adults. *Arch Neurol*, 1995; 52(5): 491-95
- [5]. Berlin L et al cerebral thrombosis in young adults *NEJM* 1995; 252: 162-166.
- [6]. Kittner SJ, Stern BJ, Wozniak M, Buchholz DW, Early CJ, Feaser BR, et al. Cerebral infarction in young adults: The Baltimore-Washington Cooperative Young Stroke Study. *Neurology* 1998; 50: 890-4.
- [7]. Srinivasan K. Ischemic cerebrovascular disease in the young. Two common Causes in India. *Stroke*, 1984; 15(4): 733-35

- [8]. Bansal BC, Prakash C, Jain AL, Brahmamandam KR: Cerebrovascular Disease in young individuals below the age of 40 years. *Neurol India*, 1973; 21(1): 11-18
- [9]. Chopra JS, Prabhakar S: Clinical features and risk factors in stroke in Young. *Acta Neurol Scand*, 1979; 60(5): 289-300
- [10]. Radhakrishnan K, Ashok PP, Sridharan R, Mousa ME: Stroke in the young: Incidence and pattern in Benghazi, Libya. *Acta Neurol Scand*, 1986; 73(4): 434-38
- [11]. Osuntokan BO, Badamosi O, Akinkugbe OO et al: Incidence of stroke in an African City: results from the Stroke Registry at Ibadan, Nigeria. 1973-1975. *Stroke*, 1979- 10(2): 205-7
- [12]. Dalal PM: Strokes (CVD) in the young. In Chopra JS, Jagannathan K, Sawhney IMS (eds). *Advances in Neurology*. Amsterdam ExcerptaMedica, 1990: 73-84
- [13]. Dalal PM: Strokes in the young in West Central India. In Goldstein LB. New York: Raven Press, 1979: 339-48
- [14]. Leno C, Berciano J, Combarrows O et al: A prospective study of stroke In young adults in Cantabria, Spain. *Stroke*, 1993; 24(6): 792-9513.
- [15]. Bevan H, Sharma K, Bradley W: stroke in young adults. *Stroke*, 1990; 21(3): 382-86
- [16]. Hart RG, Miller VT: Cerebral infarction in young adults: A practical Approach. *Stroke*, 1983; 14: 110-14
- [17]. Bogousslavsky J, Pierre P: Ischemic stroke in patients under age 45. *Neurol Clin*. 1992; 10(1): 113-24
- [18]. Nayak SD, Nair M, Radhakrishnan K, Sarma PS: Ischemic stroke in The young adult: clinical features risk factors and outcome. *Natl Med J India*, 1997; 10(3): 107-12
- [19]. World Health Organisation, Preventing Chronic Diseases. A vital investment. Geneva, Switzerland 2005.
- [20]. Feigin V, Lawes C, Bennet D, Barker Cello S, Parag V. Worldwide stroke Incidence and early case fatality in 56 population based studies: a systematic Review. *Lancet Neurology* 2009; 8 (4): 355-369
- [21]. Feigin VL, Lawces CM, Bennett DA, Anderson CS, Stroke epidemiology: A review of population-based studies of incidence, prevalence, and casefatality In the late 20th century. *Lancet Neurol* 2003; 2:43-53.
- [22]. Das SK, Banerjee TK, Biswas A, Roy T, Raut DK, Mukherjee CS, et al: A Prospective community-based study of stroke in Kolkata, India. *Stroke* 2007; 38: 906-10.
- [23]. Dalal PM, Malik S, Bhattarjee M, Trivedi ND, Vairale J, Bhat P. et al. Population-based stroke survey in Mumbai, India: Incidence and 28-day case Fatality. *Neuroepidemiology* 2008; 31:254-61.
- [24]. Man Mohan Mehndriatta, Puneet Agarwal, Kaushik Sen, Bhawana Sharma Stroke in young adults: a study from a university hospital I north India *Med Sci Monit*, 2004: 10(9) CR535-541
- [25]. F. Owolabi, A.Ibrahim Stroke in young adults: a prospective study from Northwestern Nigeria *ISRN Neurology* volume 2012.
- [26]. Putaala J, Metso AJ, Metso TM, Konkola N, Kraemer Y, Haapaniemi E, et al. Analysis of 1008 consecutive patients aged 15 to 49 with first-ever ischemic Stroke: The Helsinki young stroke registry. *Stroke* 2009; 40: 1195-203.
- [27]. Cerrato P, Grasso M, Imperiale D, Priano L, Baima C, Giraud M, Riz Zuto A, Azzaro C, Lentini A, Bergamasco B. Stroke in young patients: Etiopathogenesis and Risk Factors in Different Age Classes *Cerebrovasc Dis* 2004; 18: 154-159.
- [28]. Lipska K, Sylaja PN, Sarma PS, Thankappan KR, Kutty VR, Vasana RS et al: Risk factors for acute ischemic stroke in young adults in South India. *J. Neurol Neurosurg Psychiatry* 2007; 78:959-63.
- [29]. Lee TH, Hsu WC, Chen CJ, Chen ST. Etiologic study of young ischemic Stroke I Taiwan. *Stroke* 2002;33: 191-5.
- [30]. Netelchev K, der Maur TA, Geurjiadis D, Arnold M, Caso V, MattleHP, et al: Ischemic stroke in young adults: Predictor of outcome and recurrence. *J Neurol Neurosurg Psychiatry* 2005; 76: 191-5.
- [31]. GulcinBenbir, Derya ULUDUZ, Birsen INCE, Aysegul GUNDUZ Clinical characteristics and risk factors in young stroke *Egaline Journal of Internal Medicine, Quarter One*, 2007.
- [32]. Lanzino G, Andreoli, A, Di, Paaquale G, Urbinati S, Limoni P, Sermacchioli A, Et al: Etiopathogenesis and prognosis of cerebral ischemia in young adults. A Survey of 155 treated patients. *Acta Neurol Scand* 1991;84:321-5.
- [33]. V. Larrue, N. Berhoune, P. Massabuau, et al: Etiologic investigations of Ischemic stroke in young adults *Neurology* 2011; 76: 1983
- [34]. Choudhary R, Grover A, Varma K et al: Active infective endocarditis Observed in an Indian hospital 1981-1991. *Am J. Cardio*, 1992;70; 1453-58
- [35]. Nagaraja D, Christopher R, Tripathi M.: Anticardiolipn antibodies in Ischemic stroke in young Indian experience *J Neural Sciences*, 1997; 150: 137-42
- [36]. Krishensen B, Malm J, Carlberg B, Stegmayr B, Backman C, Fagerhund M, Et al; Epidemiology and etiology of ischemic stroke in yung adults aged 18 to 44 years I northern Sweden. *Stroke* 1997;28: 1702-9.
- [37]. Jacobs BS, Boden-Albala B, Lin IF, Sacco RL. Stroke in the young in the Northern Manhattan stroke study. *Stroke* 2002;33: 2789-93.
- [38]. Leys D, Bandu L, Hemon H, Lucas C, Mounier-Vehier F, Rondepierre P, et al.Clinical outcome in 287 consecutive young adults (15 to 45 years) with Ischemic stroke. *Neurology* 2002;59:26-33.
- [39]. Jose M, Ferro, Aynton R Massaro, Jean-Louis Mas Aetiological diagnosis of Ischemic stroke in young adults *Lancet Neurol* 2010; 9: 1085-96.
- [40]. Kameshwar Prasad, Kapil K, Singhal stroke in young: An Indian perspective *Neurology India / May-June 2010/ Vol 58/ Issue 3*
- [41]. Manjari Tripathi and Deepti Vibha in Young in India: Stroke Reseqarch and Treatment, Volume 2011.
- [42]. Jose Biller, Betay B, Love, Michael J Schneck *Vascular Diseases of the NervousSystem Ischemic Cerebrovascular Disease Chapter 51 A. Neurology In Clinical Practice, Principles of Diagnosis and Management Fifth Edition Edited by Walter G. Bradley.*
- [43]. Jose Biller *Stroke in children and young adults 2nd edition.*

Dr. T. Sateesh Kumar. "A Study of Etiological Profile of Stroke in Young Adults." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 11, 2019, pp 01-08.