Original Article

Evaluation of Pattern of Lesions Depicted on Brain Computed Tomography Scan of Patients Presenting with Stroke in Zaria, Nigeria

Mubarak Zubair Abdullahi, Halima Mono Mohammad, Suleiman Lawal, Muhammad Zaria Ibrahim, Nafisa Bello, Ibrahim Aliyu, Rasheed Mono Muhammad

Department of Radiology, Ahmadu Bello University Teaching Hospital, Zaria, Nigeria

Abstract

Introduction: Stroke is a major public health problem worldwide and it is the third leading cause of death in industrialized countries and ranks among the five most common causes of hospital deaths in adults in Africa. Accurate stroke diagnosis has a high significance for patient's outcome. Computed tomography (CT) brain scan is the imaging of choice for patients presenting to the emergency department with stroke. **Aim and Objectives:** The study aimed at evaluating the pattern of lesion depicted on CT brain of patients presenting with stroke in ABUTH, Zaria. **Materials and Methods:** A prospective review of CT findings in 155 patients who presented in the Radiology Department of Ahmadu Bello University Teaching Hospital (ABUTH) with clinical diagnosis of stroke was undertaken over a period of six months (from October 2017 to April 2018).. **Results:** Of the 155 patients seen within the period under review, 88 (56.8%) were males while 67 (43.2%) were females. Age range was 11–90 years (mean 56, standard deviation (SD) 16, 44(28.4%) of patients were in the age group of 61–70 years. Ninety six patients (61.9%) had ischaemic stroke, 27(17.4%) had hemorrhagic stroke, eight (5.2%) was stroke mimic, six patients (3.9%) mixed lesions (ie both ischaemic and haemorrhagic). Eighteen patients (11.6%) had normal brain CT findings. The region most affected by stroke was the parietal region 52(38%). **Conclusion:** Ischaemic stroke is the most common form of stroke in this study.

Keywords: *Cerebral, computerized tomography, hemorrhage, ischaemia, stroke*

Introduction

Stroke is defined as a clinical syndrome consisting of rapidly developing clinical signs of focal or global (in the case of coma) disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than a vascular origin.[1] Stroke is a syndrome caused by disruption of the blood flow to part of the brain due to either (a) occlusion of a blood vessel (ischemic stroke) or (b) rupture of a blood vessel (hemorrhagic) resulting in injury to cells and causing sudden loss of focal brain-functions. Stroke is the most important single cause of severe disability in adults and the second most common cause of death after coronary heart disease in the world.[1]

In developing countries, increased life expectancy has modified the pattern of cause-specific mortality, with a higher burden of cardiovascular diseases (CVD).[1,2] The frequency of stroke in South East Asia and Africa, of hospital populations has varied from 0.9% to 4.0%.[3] At Lagos University Teaching Hospital stroke was the most common cause of neurological admission.[3] Computed Tomography has certain advantages over other imaging modalities such as its reliability in showing clear difference between cerebral infarction and hemorrhage.[2] The availability and utilization of this imaging modality has significantly reduced mortality and morbidity from CVDs by way of prompt diagnosis, guiding intervention, and follow up. They are not readily available in the majority of hospitals in the developing countries. This study intends to show patterns of lesions depicted on brain CT scans in patients with stroke types in this environment and possible mimic conditions such as tumors, AVMs, abscesses, radiation necrosis, and brain atrophy that can mislead the clinician in diagnosis of stroke. This could potentially improve the quality of care in management of stroke and also add to the existing body of knowledge in

How to cite this article: Abdullahi MZ, Mohammad HM, Lawal S, Ibrahim MZ, Bello N, Aliyu I, *et al*. Evaluation of pattern of lesions depicted on brain computed tomography scan of patients presenting with stroke in Zaria, Nigeria. J West Afr Coll Surg 2023;13:16-21.

Received: 26-Oct-2022
Accepted: 18-Nov-2022
Published: 27-Jun-2023

Address for correspondence:
Dr. Mubarak Zubair Abdullahi, Department of Radiology Ahmadu Bello University Teaching Hospital, Zaria, Nigeria.
E-mail: mubarakaz11@gmail.com

Access this article online

Website: www.jwacs-jcoac.com

DOI: 10.4103/jwas.jwas_256_22

Quick Response Code:

this field. The population of Nigerians that suffer from stroke is on the increase, recent hospital statistics suggests that more than 160,000 Nigerians develop stroke yearly,[3] but literature regarding the pattern of lesions depicted in CT scan of the brain of patients presenting with stroke in the Northwestern region of Nigeria are insufficient. There is need for improved stroke data collection in developing nations like Nigeria and in Northern Nigeria in particular, in order to elucidate the relevant factors, magnitude and trends of stroke in this region. The result of this study can be used as a baseline data and for planning further research on this subject.

Aim

To assess the pattern of lesions on brain CT scan of adult patients presenting with stroke in Ahmadu Bello University Teaching Hospital Shika, Zaria.

Materials and Methods

Study design

This was a descriptive prospective case series of adult patients that presented with Stroke in ABUTH Shika Zaria.

Study period

This study was conducted within a period of 6 months after approval was received from the ethical committee of ABUTH.

Study population

The study subjects was made up of 155 consecutive patients who were referred to the Radiology Department with signs and symptoms of stroke for brain CT examination.

Exclusion criteria

Non-consenting patients, Clinical evidence of tumour, head injury, neuro-infections and patients with history of contrast medium allergies or renal failure.

Study technique

An intravenous line was set on the right hand, arm or forearm under aseptic condition using 18–20-gauge needle canula. Restless patients were sedated. Metallic hardware, including dental and hair prostheses, were removed from the patient.

All subjects were scanned from the vertex to the base of the skull in supine position using the 2 slice GE Hi-speed spiral CT scanner, the patient were made to lie in supine position on the CT couch. The head is placed on the head rest and supported using head immobilization pads with straps and then introduced into the gantry. The straps and pads were used to maintain the correct head position.

In order to prevent unnecessary irradiation of the orbit, especially the lens, the head CT is performed at an angle parallel to the infra-orbitomeatal line. The couch with the patient was introduced into the gantry where the tube rotates around the patient's head in the gantry. The laser beam was used for indicating the starting and end point of the scan. The door of the CT room was closed and the radiographer after checking all the settings (parameters) then carried out the examination and acquired the images.

Standard NCCT was performed with a multi-slice CT scanner (GE Medical Systems) using 120 kV, 170 mA, 2second scan time, and 5 mm slice thickness.

After making sure there is justification for the brain CTA, contrast study was done only if hemorrhage had been ruled out, NCCT scanning was followed on the same scanner by contrast bolus CT imaging with a helical scan technique (CT angiography.10 Acquisitions were obtained after a single bolus intravenous contrast injection of 90 to120 mL of non-ionic contrast into an ante-cubital vein at 3 to 4 ml/s with a 20 to 25 s delay from the start of the contrast injection to the onset of imaging. The image sequence covered the foramen magnum to centrum semiovale or vertex with a scan field of view (25.0 cm; 140 kV, 170 mA; table speed 3.75 mm/s; 2.5 mm slice thickness with 2.5 mm interval; 1.0 s per rotation). Source images (CTA-SI) were reconstructed to 1.25 mm thickness at 0.625 mm intervals.

Reconstructions were also done to help in assessing the relationship of the lesion to the surrounding structures.

The CT findings were classified into pathological types and site of occurrence.

Data analysis

All images were reviewed digitally at a workstation with a large high-resolution monitor. The generated data was entered into a computer data base. Statistical package for social sciences (SPSS) for windows version 21.0 (2016 IBM USA) was used to analyze the data using descriptive and inferential statistical methods and displayed by various statistical presentations.

Results

During the study period, 155 subjects presented with acute stroke and of these subjects, 88 (56.8%) were males and 67 (43.2%) were females with a male to female ratio of 1.3:1. The age range of the subjects was between 11 and 90 years with a mean age of 56 (±16) years [Table 1]. Out of the 155 subjects, 137 had abnormal brain CT findings while the remaining 18 subjects were apparently normal on brain CT [Figure 1].

However, the patterns of the abnormal findings are ischaemic stroke [Figure 2], haemorrhagic stroke, mixed lesions (both haemorrhagic and ischaemic) and stroke mimics (brain atrophy, brain tumours, AVM and abscess). The frequencies in this study is; acute ischaemic stroke 96 (61.9%) occurring most in the 61-70years age group while

Table 1: Age-sex distribution

Age group	SEX		TOTAL
	Female (%)	Males (%)	
11-20	1(0.6)	4(2.6)	5(3.2)
21-30	2 (1.3)	5(3.2)	7(4.5)
31-40	6 (3.9)	8(5.2)	14 (9.0)
41-50	8 (5.2)	10(6.5)	18 (11.6)
51-60	17 (11.0)	25 (16.1)	42 (27.1)
61-70	19 (12.3)	25 (16.1)	44 (28.4)
71-80	10 (6.5)	9 (5.8)	19 (12.3)
81-90	4(2.6)	2 (1.3)	6 (3.9)
Total	67 (43.2)	88 (56.8)	155 (100.0)

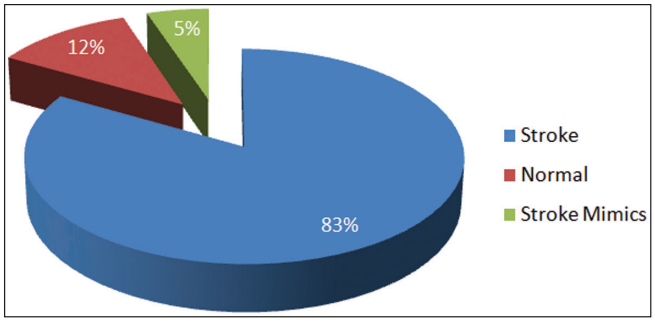

Figure 1: Pie chart showing the number of subjects with normal and abnormal CT findings (stroke and stroke mimics)

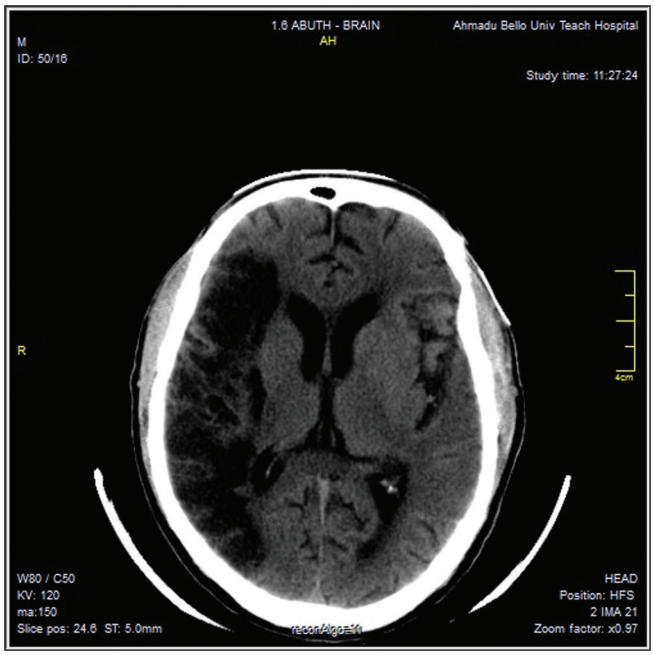

Figure 2: Non Contrast Axial CT image of the brain of a patient showing an extensive infarct involving the right fronto-parietal lobe

haemorrhagic stroke is 27 (17.4%).The least in the study was mixed lesions 6 (3.9%) which comprises both ischaemic and haemorrhagic strokes [Table 2] while [Table 3] shows that only 15 patients (9.7%) were scanned within the 24 hours of stroke onset and majority of the patients 62 (40%) were between 7 – 14 days.

Discussion

In a study by Salawu *et al*[3] on CT stroke profile and clinical scoring in Maiduguri, the mean age of the patients was 55.4years, is closer to the mean age of the index study while a study of stroke diagnosis with CT in Enugu by Onwukeme *et al.*[4] had a lower mean age at 53years. Other Nigerian studies have similar mean age with that in the index study.[5]

However a study in Calabar,[6] showed the mean age for individuals with stroke to fall below 50 years, the youngest being 26 years. The probable explanation could be because of the culinary and sedentary lifestyle of the Calabar environment in Nigeria. It is also possible that the younger men are more likely to carry out a CT scan and aim for expert and prompt treatment because the stroke occurs in the prime time of their lives.[7] The most commonly affected age group was 61-70 years in both sexes.

All these are in variance with the National Stroke Association (2014), who stated that, most stroke cases occur in people aged over 65 years, but agrees with the findings of Nwosu[8] who reported that in industrialized countries of Europe and North America, half of stroke cases occurs before the age of 75 years, while in developing countries like Southeast Asia and Africa, the peak age is 1 to 2 decades earlier than in the industrialized countries. This may be due to preventable circumstances such as ignorance, undetected and poorly-managed conditions like hypertension, diabetes, inadequate health care facilities, poor socio-economic factors, racial factor, and poor health-seeking behavior among others.

Out of the 155 brain CT scan results evaluated, 88 (56.8%) were males and 67 (43.2%) females with male to female ratio of 1.3:1. This is similar to the findings of Eze, *et al.* as cited by Geofery,*et al.*[9] where 66.70% of subjects were males and 33.30% were females, and Nwosu[8] reported that for every three female stroke patients there are approximately four to five males. This may be due to the high risk behaviors like smoking and alcoholism and stress as males are the bread winners among others that may predispose males to conditions like hypertension, and post traumatic stroke, although, the female folks may not be completely exonerated from some of this risky behaviors as well.

Table 2: Stroke type by age

Age group	Stroke Type					Total
	Ischaemia	Haemorrhage	Mixed	Normal	*Stroke Mimic	
11-20	2(1.3)	3(1.9)	0(0.0)	0(0.0)	0(0.0)	5(3.2)
21-30	5(3.2)	0(0.0)	0(0.0)	2(1.3)	0(0.0)	7(4.5)
31-40	10(6.5)	2(1.3)	0(0.0)	2(1.3)	0(0.0)	14(9.0)
41-50	10(6.5)	4(2.6)	0(0.0)	4(2.6)	0(0.0)	18(11.6)
51-60	22(14.2)	7(4.5)	3(1.9)	5(3.2)	5(3.2)	42(27.1)
61-70	29(18.7)	7(4.5)	2(1.3)	3(1.9)	3(1.9)	44(28.4)
71-80	14(9.0)	3(1.9)	1(0.6)	1(0.6)	0(0.0)	19(12.3)
81-90	4(2.6)	1(0.6)	0(0.0)	1(0.6)	0(0.0)	6(3.9)
Total	96(61.9)	27(17.4)	6(3.9)	18(11.6)	8(5.2)	155(100.0)

Table 3: Stroke type by Time of presentation for CT examination

CT presentation Time	Stroke Type (%)					Total
	Ischaemia	Haemorrhage	Mixed	Normal	*Stroke Mimic	
< 1 day	8(5.2)	3(1.9)	1(0.6)	3(1.9)	0(0.0)	15(9.7)
1 – 7 days	32(20.6)	7(4.5)	0(0.0)	4(2.6)	3(1.9)	46(29.7)
7-14 days	40(25.8)	8(5.2)	3(1.9)	7(4.5)	4(2.6)	62(40.0)
> 14 days	16(10.3)	9(5.8)	2(1.3)	4(2.6)	1(0.6)	32(20.6)
Total	96(61.9)	27(17.4)	6(3.9)	18(11.6)	8(5.2)	155(100.0)

Ischaemic stroke was the most observed in the index study occurring in 63.2% of subjects [Figure 2]. This finding is in support of the report by Onwuchekwa *et al.* in their study on stroke in young adult in PPortHarcourt.[4] It is also similar to the observation of stroke in the general population, where 72% of stroke patients had cerebral infarct in a study in North East Melbourne stroke incidence study (NEMESIS).[10] Our finding differs with the finding by Obajimi, *et al.*[11] who reported a higher incidence of intracranial hemorrhage of up to 52.9% among Ghanaians. The study concluded that the high rates were due to untreated hypertension among the subjects.[12] A similar report by Ogun, *et al.*[13] did a 10-year review study at Ogun state teaching hospital for 708 patients, from 1993 to 2003 in which hemorrhagic stroke accounted for 45% and 49% of the patients had cerebral infarction. However, Obajimi and Ogun's studies are over 10 years old and that was the finding then. The pattern has changed now with ischaemic being higher as indicated in recent studies and the index study. This change in pattern could be as a result in a change in lifestyle and eating habits.

Haemorrhagic stroke was seen in 15.8% of subjects. This finding is in agreement with previous studies that reported a higher prevalence of ischemic than hemorrhagic stroke in southwestern Nigeria.[14]

Haemorrhagic stroke affected more males than females in the ratio of 2:1 in this study. This agrees with Nighossian *et al.*[15] A study conducted in Nepal revealed the combination of smoking and alcohol drinking to be the highest risk factor for hemorrhagic stroke[16] which may be the likely the reason male are more predisposed to haemorrhagic stroke than female.

The hemorrhagic type of stroke occurred in the older age group, with 33% of subjects occurring in less than 50 years of age and 67% of subjects affecting more than 50 years of age. This is in agreement to the findings of Eze, *et al*[17] in Enugu, South Eastern Nigeria who showed that haemorrhagic stroke was significantly more common in patients between 60 and 90 years of age, whereas the ischaemic type was seen in the 50-59 year age group. This could be explained by the fact that the intracranial vessels are weaker in the older age or increased incidence of haemorrhagic stroke in the elderly could be due to haemorrhagic transformation of ischaemic stroke.

The importance of the CT scan is highlighted by the fact that several conditions may mimic a stroke. In this study, a total of 155 patients were studied, among them 5.2% were inflicted with mimics of brain stroke. This figure is similar to studies done in Europe in which stroke mimics ranges widely from 1.2% to 31%,[18] and in Japan is 6.7%, even when neurosurgical specialists are involved in patient examination.[19] However the finding in the index study is quite lower than another Nigerian study that showed stroke mimics be to 23%.[4] While an American study showed stroke mimic to be 13%.[20] These studies supports the index study that stroke mimics is not uncommon disease. The availability of a CT scan indeed contributes significantly to the direction of their appropriate diagnosis and management.

In the index study, only 9.7% of the patients scanned presented within the first 24hours for CT examination after onset of stroke but none presented within the crucial 6 hours from onset of stroke while more than 90% of the patients presented after 24 hours. Most

of these cases were referral cases from within and outside the index locality of study and have presented initially in a peripheral health facility before being referred to our health facility and hence the reason for the late presentation.There are several other possible explanations for this delay. Some of these factors have been enumerated by previous authors working in similar environments.[21] Recent studies from Nigeria and other parts of Africa indicate that a great proportion of people were not aware of the warning signs of a stroke.[22] This supports the assertion that patients' lack of knowledge about stroke may be a major factor responsible for delayed presentation in hospitals.[23] However, there was no statistically significant relationship between stroke type and CT examination time in this study.

Limitations

This is a hospital- based study, therefore, there is a possibility that very severe cases may be over-represented,mild and fatal cases totally excluded. Also patients who could not pay were probably excluded since the hospital charges fees for the CT scan. Also patients who believed in traditional treatment of stroke that do not rely on CT for diagnosis were probably also not captured and thus excluded in the study. Case ascertainment was done through radiological reports. During the period under review, there were times when the CT machine was out of service and cases during such periods were missed. A multi-center study may be preferable.

A 2-Slice CT with 5mm slices offers very low resolution and hence a high chance of missing lesions especially with the significant proportion of normal studies. However a higher order multislice (16 and above) CT may reduce the proportion of false negative scans and improve study validity.

Inability to carry out perfusion scan as well as angiographic studies.

Conclusion

Computed Tomography scan is of utmost importance in establishing the diagnosis, differentiating between hemorrhagic and ischaemic stroke and also helps in optimizing the therapy for patients with stroke. Ischaemic stroke is the commonest form of stroke in this study. The study has shown the varying patterns of stoke lesions on computed tomography scan as it relates to sex,and age.CT imaging presentation time of more than 90% of patients in more than 24 hours for stroke patients in a major tertiary Nigerian hospital represents a significant delay in stroke care and management. This undesirable delay is also considerably greater among ischemic stroke patients. The long time interval before imaging diagnosis leaves little room for meaningful intervention that could limit disability in stroke patients.

Financial support and sponsorship

Not applicable.

Conflicts of interest

There are no conflicts of interest.

References

1. Beauchamp N, Barker P, Wang P, VanZijl P. Imaging of acute cerebral ischemia. Radiology 1999;212:307-24.
2. Srinivasan A, Goyal M, Azri FAl, Lum C. State-of-the-Art Imaging of Acute Stroke. RadioGraphics 2006;26(suppl_1) :S75-95.
3. Demchuk AM, Goyal M, Yeatts SD, Carrozzella J, Foster LD, Qazi E, *et al*. Recanalization and clinical outcome of occlusion sites at baseline CT angiography in the interventional management of stroke III trial. Radiology 2014; 273:202-210.
4. Onwukeme IO, Ezeala-Adikaibe BA, Ohaegbulam SC, Chikani MC, Amuta J, Uloh HN. Stroke Mimics – A Study of CT images in Nigerian African stroke patients. J Neurol Sci (Turkish) 2008;25:143-9.
5. Suleiman HM, Aliyu IS, Abubakar SA, Isa MS, El-Bashir JM, Adamu R, *et al*. Cardiac troponin T and creatine kinase MB fraction level among patients with acute ischemic stroke in Nigeria. Nigerian Journal of Clinical Practice 2017;20:1618-21.
6. Ikpeme AA, Bassey DE, Oku AO, Ephraim PE. Computerized tomography findings of cerebrovascular disease in adults in Calabar, Nigeria. West Afr J Radiol. 2014;21:12-6.
7. Adams H, Adams R, Del Zoppo G, Goldstein LB. Guidelines for the early management of patients with ischemic stroke: 2005 guidelines update a scientific statement from the Stroke Council of the American Heart Association/American Stroke Association. Stroke 2005;36:916-23.
8. Nwosu M. Epidemiology of Stroke - an overview. J Med Investig Pract 2001;3:14-22.
9. Geogery L, Pindiga BY, Ahmadu MS, Nwobi IC, Eze CU, Aminu UU, *et al*. Evaluation of patients presenting with stroke in a teriary hospital in Northern Nigeria. IJAR 2015;3:1216-22.
10. Thrift A, Downy H, Donnan G. Incidence of the major stroke subtypes. Stroke 2001;32:1732-8.
11. Obajimi MO, Nyame PK, Jumah KB, Wiredu EK. Spontaneous intracranial haemorhage: Computed tomographic patterns in Accra. West Afr J Med 2002;21:60-2.
12. Matuja W, Janabi M, Kazema R, Mashuke D. Stroke subtypes in Black Tanzanians: a retrospective study of computerized tomography scan diagnoses at Muhimbili National Hospital Dar es Salaam. Trop Doct 2004;34:144-6.
13. Ogun SA, Oluwole O, Fatade B, Ojini F, Odusote KA, Ogunseyinde AO. Accuracy of the Siriraj Stroke Score in differentiating cerebral haemorrhage and infarction in African Nigerians. Afr J Neurol Sci 2001;20:21-6.
14. Salawu F, Umar I, Danburam A. Comparison of two Hospital Stroke Scores With Computed Tomography in ascertaining Stroke type among Nigerians. Ann Afr Med 2009;8:14-52.
15. Nighoghossian N, Hermier M, Adeleine P, Honnorat J. Old microbleeds are a potential risk factor for cerebral bleeding after ischaemic stroke. Stroke 2002;33:735-42.
16. Kiridi E, Dambo N. CT Scan in Yenagoa, Bayelsa State: A Review of the First 156 Cases. AASCIT Journal of Health 2015;2:93-7.

17. Eze CU, Okaro AO, Ohagwu CC. Pattern of computed tomograpghy findings in cerbrovascular accidents in South Eastern Nigeria. A retropsective study of 480 patients. Eur J Sci Res 2009;34:104-9.
18. Hand PJ, Kwan J, Lidley RI, Dennis MS, Wardlaw JM.
19. Sato T, Komuro T, Kobayashi A. Stroke mimics admitted to neurosurgery ward. Prog Med 2014;34:793-9.
20. Distinguishing between stroke and mimic at the bedside. Stroke 2006;37:769-75.
21. Ogbole GI, Ogunseyinde AO, Obajimi MO, Ogunseyinde OA, Ogunniyi A. Experience with three-dimensional computed tomographic angiography in Ibadan, Nigeria. Niger J Clin Pract 2010;13:187-94.
22. Owolabi MO. Taming the burgeoning stroke epidemic in Africa: stroke quadrangle to the rescue. West Indian Med J 2011;60: 412-21.
23. Clifton RL, Suh D, Bueno M, Kostis JB. Delay in Presentation and Evaluation for Acute Stroke. Stroke 2001;32:63-6.