Early and Delayed Fatality of Stroke in Kolkata, India: Results From a 7-Year Longitudinal Population-Based Study

Biman K. Ray, DM,* Avijit Hazra, MD,† Malay Ghosal, MD,‡ Tapas Banerjee, FRCP,§ Arijit Chaudhuri, PhD,¶ Vineeta Singh, MD,‖ and Shyamal Kumar Das, DM*

There is no previously published well-designed study on long-term outcome of stroke from India. The present study has examined the case fatality rate and survival pattern in patients with stroke in a stratified, randomly selected sample from a large Indian metropolitan area. This prospective study was conducted over 7 years (March 2003 to February 2010) using a validated questionnaire administered by a field team and headed by a neurologist. A cross-sectional house-to-house survey was repeated twice yearly. A verbal autopsy was performed to assess cases of death. The Kaplan-Meier method was applied for survival analysis. A cohort of 763 stroke cases were followed up. The overall stroke fatality was approximately 59% at 5 years and 61% at 7 years. Early fatality was 33% within 7 days and 42% within 30 days. Men were at greater risk of death than women. Logistic regression analysis revealed male sex and diabetes to be important predictors of fatality. The majority of deaths were attributable to the index stroke (70%), followed by recurrent stroke (19%) and cardiovascular causes (7%). Beyond the first year, recurrent stroke was by far the most common cause of death. Median survival time exceeded the 84-month observation period when 30-day fatalities were excluded. Early stroke fatality is higher in this study compared with reports from developed countries, but long-term survival is similar. Beyond 1 year, the causes of stroke fatality are similar to that reported in other Asian populations. Access to acute stroke care and appropriate preventive strategy are urgently needed to reduce early stroke fatality in India. **Key Words:** Epidemiology—India—incidence—death—risk factor—survival analysis.

Stroke is an important cause of adult death and disability worldwide. Death after stroke is considered common in low- and middle-income countries according to data generated by the World Health Organization's Global Burden of Disease program.[1] An epidemic of stroke may be imminent in India considering its status as a middle-income country, the growing elderly population, and the increasing prevalence of risk factors.[2] Community studies of stroke from 2 separate regions of India have revealed both higher incidence and earlier case fatality than have been reported from many developed countries.[3,4] Thus, it is important to document long-term survival trends in stroke in India and to identify predictors of fatality. Given stroke's important medical, social, and familial connotations,[5] this effort will be beneficial in planning preventive strategies and in developing the necessary health care delivery services. Consequently, we conducted a 7-year prospective community-based study to assess

From the *Department of Neurology, Bangur Institute of Neuroscience, Kolkata, India; †Department of Pharmacology, Institute of Postgraduate Medical Education and Research, Kolkata, India; ‡Department of Psychiatry, Institute of Psychiatry, Kolkata, India; §Department of Neurology, National Neuroscience Centre, Kolkata, India; ¶Sampling Unit, Indian Statistical Institute, Kolkata, India; and ‖Department of Neurology, University of California San Francisco, San Francisco, California.

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Address correspondence to Shyamal Kumar Das, DM, Department of Neurology, Bangur Institute of Neuroscience and Institute of Postgraduate Medical Education and Research, Kolkata 700025, India. E-mail: das_sk70@hotmail.com.

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stroke incidence, case fatality, and survival trends in a large, randomly selected sample in an metropolitan area of India.

Materials and Methods

The study was conducted as a prospective community-based survey in Kolkata, the largest metropolis in eastern India, from March 2003 through February 2010. Details of the sampling strategy have been described elsewhere.[5] In brief, the municipal area of Kolkata is divided into 5200 National Sample Survey Organization (NSSO) blocks. Complete data for each block, including geographical landmarks, boundaries, and types of housing, are available. Based on this information, the city was divided into 6 strata (stratum I, slum area; strata II-VI, nonslum areas). From each stratum, a number of blocks were selected (proportionate to the population) using a random number list. From each block, 50% of the households were surveyed. A total of 282 blocks were selected, which enabled screening a population of 100,802 for the incidence study. All sampled individuals had to be residents of Kolkata for at least 1 year for inclusion.

The field survey team comprised 4 trained field workers with expertise in epidemiologic work, supervised by a neurologist. The team performed door-to-door surveys at 6-month intervals using a preset questionnaire[6] with 3 parts: demographic data (part I), the screening questionnaire (part II), and a comprehensive validated questionnaire related to stroke including verbal autopsy (part III). The latter component is a World Health Organization–recommended interview-based report on the cause of death implemented in situations where direct autopsy is limited,[7] taking into account symptoms, signs, illness duration, and treatment details provided by a close observer at the time of death. In the present study, a senior neurologist's evaluation of cause of death due to stroke served as the gold standard.

The study design was approved by the Institutional Ethics Committee of the Institute of Postgraduate Medical Education and Research, Kolkata. Informed consent was obtained from each participant before the initial interview.

Operational Definitions

As in a previous study,[3] stroke was defined as rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or more or leading to death, with no apparent cause other than mechanisms of vascular origin. Cases of transient ischemic attack were excluded. First-ever stroke (FES) was defined as clinical stroke occurring in patients with no previous stroke event. Only those cases of FES occurring between March 1, 2003, and February 28, 2010, were considered for longitudinal analysis. Deaths occurring within the first 7 days and within the first 30 days of onset of incident stroke were used to assess 7-day and 30-day case fatality rates (CFRs).

Recurrent stroke was defined as new stroke events occurring after 24 hours and 28 days of the index event.[8] For calculating stroke mortality, we used the first definition, of recurrent stroke after 24 hours.

Slums were defined as urban regions in which migrants from rural areas lived in unhygienic and overcrowded conditions and were of low socioeconomic status.[5]

Along with age, sex, and place of residence, other risk factors were defined as follows. Hypertension was defined as systolic blood pressure >140 mm Hg and/or diastolic blood pressure >90 mm Hg or receipt of antihypertensive medication (JNC-VII criteria: Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure).

Diabetes mellitus was defined as fasting blood glucose level ≥126 mg/dL, 2-hour postchallenge glucose level ≥200 mg/dL, or receipt of antidiabetic medication.

Ischemic heart disease was defined as signs and symptoms suggestive of effort angina, myocardial infarction, irregular heartbeat, cardiac failure, and sudden death (World Health Organization criteria). A diagnosis of ischemic heart disease was made if one or more criteria were satisfied.

Smoking was defined as both current and former smokers (inhalant) within the last 15 years.

Nonsmoking tobacco use was defined as chewing of tobacco products.

Alcohol intake was defined as minimum daily intake of 1 standard drink, equivalent to 10 g or more of pure alcohol, in the last year, either regularly or intermittently. We did not grade alcohol intake into different categories, given that alcohol consumption is not common in the study population.

Causes of death were categorized into 5 groups according to the Oxford Stroke Study classification scheme[9]; group I, deaths due to direct effects within 30 days of the initial event; group II, deaths occurring within 30 days of a recurrent stroke event; group III, deaths due to possible or definite ischemic heart disease; group IV, deaths due to nonvascular causes (eg, cancer, injury); group V, deaths due to undetermined causes.

Quality Assurance

The sensitivity (99.9%) and specificity (83.3%) of our screening instrument for detection of stroke has been reported previously.[3] Patients who were hospitalized were traced, and clinical details recorded after discharge or death and relevant certificates were reviewed. All known old-age homes within the study area were visited to maximize case detection, though this did not actually increase the stroke survivor count. In cases of first-time refusal, 2 further attempts were made to contact the individual before giving up. All case records collected by the field team