Cost and Value of Technical Medicine for Diagnosis and Treatment of Cerebrovascular Disease
Problems in the Developing Countries

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If "health for all by the year 2000" is the realistic goal of W.H.O.,1) and that of the World Federation of Neurology, all expert groups in communicable and non-communicable diseases will have to understand some basic problems facing the developing countries.

Firstly, the third world countries have increased the number of universities imparting fundamental and practical training in technical medicine for the "art of healing", but this is not the solution (Fig.1). Large number of trained medical personnel are attracted to lucrative jobs in developed nations. The need-gap is ever increasing.

Not only is rapid population growth the problem, it is the age distribution pattern of existing and future generations where the impact of cost and the value of technical medicine is felt. Nearly 50% of our people are under the age of 30 and therefore the diseases of aging are not of primary concern (Fig. 2). Thus, the reorganisation of available health care services to focus on those maladies prevailing in the younger age groups is our foremost need.

In addition to the above, with changing lifestyles and habit patterns and when people are striving for better living standards, both in urban and rural areas, Maslow's theory of motivation is gaining real momentum: namely, physiological needs for survival-food, water, air, sleep; security against enemy and disease; social needs—affection, love; recognition and self-respect and fulfilment of personal goals (Fig. 3).

It is becoming evident that birth control programs are showing successful results and the infant mortality rate has already dropped consequent to compulsory vaccination against infectious diseases (e.g. smallpox, cholera, polio and tuberculosis, etc). Therefore, with a striking decline in the occur-

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Third World universities expand to meet the needs

Fig. 1. Showing the growth of universities in the developing countries over the past two decades.

Fig. 2. Illustration of the age distribution pattern of populations in the developed and developing regions of the world. The two pyramids show the size and age structure of the population in developed and developing regions of the world in 1980, and as they will be in the year 2000. The coloured areas show the numbers of males and females in each 10 year age group.

In contrast to the occurrence of communicable diseases in the younger population, the incidences of noncommunicable maladies like hypertension, stroke, cardiovascular disease and cancer \(^2\) are increasing.
For example, a W.H.O. designed community screening survey for casual high blood pressure (160/95 mmHg) in "old" Bombay showed that its prevalence rate was nearly the same in the rich and in the poor socio-economic groups. When one compares the available data from the United Kingdom, Nigeria, Taiwan, United States and the Bombay study, the differences are marginal and well within the limits of variation due to chance.3)

**The Stroke Problem**

There are a few prospective studies on cerebrovascular disease (CVD) in India. For example, a random community screening survey in semiurban areas of Vellore, in South India, revealed a point-prevalence rate of 56.9/100,000 for "hemiplegia" (? CVD) and 25% of these patients were below the age of 40 years.4) Similarly, a well designed stroke study in Bombay5),6) with a high autopsy confirmation rate (86.5%) revealed that 82.7% had ischemic CVD and 17.3% had hemorrhagic CVD. In this study (1963), 298 cerebral angiograms were performed in 96 of 105 ischemic stroke subjects. Here, the authors noted:

"Though the Indian patients studied had altogether different social customs, living standards and dietary habits from Western people, the relative
incidence of various cerebral vascular lesions did not differ significantly. Irrespective of the poor nutritional status of the patients, thrombosis associated with atherosclerosis was chiefly responsible for non-embolic cerebral infarctions. Atherothrombosis in young normotensive persons not showing any evidence of arteritis, diabetes mellitus or hypercholesterolemia was also identified. 77

Likewise, an International Collaborative Study on “Geographic Pathology on Cerebral Atherosclerosis” on routine (natural) and accidental
Table III. Analysis of “Risk Factors” in 34 Cases of Cerebral Infarction

<table>
<thead>
<tr>
<th>“Risk factors”</th>
<th>Total (33)</th>
<th>Males (17)</th>
<th>Females (16)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hypertensive (6)</td>
<td>Normotensive (11)</td>
<td>Hypertensive (6)</td>
</tr>
<tr>
<td>All</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>13</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Sub-total</td>
<td>25</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>“None”</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>6</td>
<td>11</td>
</tr>
</tbody>
</table>

(Figures in parentheses indicate number of subjects who survived the ictus.)

**Risk factors:** 1. elevated cholesterol, 2. elevated triglycerides, 3. abnormal ECG/CHD, 4. diabetes mellitus, 5. smoking or tobacco use.

“None” is defined as absence of “risk factors”, excluding blood pressure levels.

Criteria for hypertension (HBP): age 20–29 yrs: over 150/90 mmHg, age 30–45 yrs: over 160/95 mmHg.

* 1 additional subject died who had all “risk factors”.

(Bombay, India; Dalal et al, 1984)

deaths (1090 subjects), showed that the “atherosclerosis index” was nearly the same as was seen in American and Japanese data; it increased with advancing age and in the presence of hypertension.8)

STROKES IN THE YOUNG INDIANS

Some reliable information is now available from two prospective studies on “Strokes in the Young” performed in Bombay. Here, general data on CVD lesions in 133 cases by age, sex and final outcome are given in Table I. The number and types of diagnostic investigations are outlined in Table II and the analysis of “risk factors” in 34 cases of cerebral infarction is shown in Table III. The relative incidence and the fatality rate in these 133 cases for various subcategories of CVD lesions during the present study period (1978–82) and for an identical study (1963–68) at these centers having a similar bias are compared in Table IV; the changing trends in morbidity and mortality patterns, as seen during these two “study periods,” are summarized in Table V.

It is interesting to note that although the relative frequency distribution of “CVD” lesions at these centers has not changed over the last two decades, there has been a significant drop in the mortality rate for ischemic stroke
Table IV. A Prospective Study on Unselected Cases: the Relative Incidence and Case Fatality Rate

<table>
<thead>
<tr>
<th>Category of CVD lesions*</th>
<th>Study period (1963 to 1968)++</th>
<th>Study period (1978 to 1982)††</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of cases</td>
<td>(%) of 93</td>
</tr>
<tr>
<td>(I) Ischemic cerebrovascular diseases</td>
<td>75/93 (80.60%)</td>
<td>17/75 (18.30%)</td>
</tr>
<tr>
<td>Cerebral thrombosis</td>
<td>19 (20.40%)</td>
<td>5 (5.40%)</td>
</tr>
<tr>
<td>Cerebral thrombolysis (thrombo-embolism)</td>
<td>22 (23.70%)</td>
<td>1 (1.08%)</td>
</tr>
<tr>
<td>Cerebral embolism</td>
<td>34 (36.50%)</td>
<td>11 (11.80%)</td>
</tr>
<tr>
<td>(II) Hemorrhagic cerebrovascular diseases</td>
<td>12/93 (12.90%)</td>
<td>9/12 (9.70%)</td>
</tr>
<tr>
<td>Intracerebral hemorrhage</td>
<td>9 (9.70%)</td>
<td>7 (7.50%)</td>
</tr>
<tr>
<td>Subarachnoid hemorrhage</td>
<td>3 (3.02%)</td>
<td>2 (2.20%)</td>
</tr>
<tr>
<td>(III) Cerebral venous thrombosis</td>
<td>6/93 (6.50%)</td>
<td>4/6 (4.30%)</td>
</tr>
<tr>
<td>(IV) Miscellaneous</td>
<td>— — — —</td>
<td>9/133 (6.77%)</td>
</tr>
<tr>
<td>Total: (93+133=226)</td>
<td>93 — 30 (32.30%)</td>
<td>133† — 13 (9.77%)</td>
</tr>
</tbody>
</table>

(Bombay, India; Dalal et al, 1984)

* Exclude cases of “hemiplegic stroke” associated with meningitis.
†† Clinical diagnosis supported by CSF: 92 cases; Angio: 101 cases; CT scan/Brain scan 30 cases; multiple tests: 88 cases.

from 32% to 10%, resulting in higher survival and with morbidity increasing from 68% to 90%. This has now posed a major problem of rehabilitation in the stroke control program.

Discussion

On stroke epidemiology per se, there are no valid data for countries in South-East Asia. Nevertheless, the use of hospital based information has potential applications in epidemiology, despite limitations. The analysis of data from various medical college hospitals in urban India has shown that nearly 2% of all hospital cases, 4.5% of medical and 20% of neurological
It has been reported that by etiology and pathology, the strokes coming to a university hospital in Bombay were not the result of an inflammatory vascular disease like syphilis, tuberculosis or arthritis, but rather the single most common cause of non-embolic cerebral infarction was thrombosis associated with premature atherosclerosis. It was also noted that nearly 82.7% of all strokes coming to community hospitals were a result of ischemic lesions and 17.3% were hemorrhagic strokes. This trend has continued over the past two decades but some changes in morbidity and mortality patterns have been observed.

This report deals only with some general observations on subjects under the age of 45 years who had a recent stroke, and came to a city hospital in Bombay, India. In this prospective study on consecutive cases, there was, by intention or otherwise, no selection of patients with respect to age, sex, race, religion, socio-economic status, severity of the disease, or associated illness; nor was the policy of the administration restrictive in regard to admission of cases of acute stroke. It was our impression, however, that subjects with transient symptoms and those dying quickly from a stroke were probably not seen by us and a small fraction of the resident population with higher economic status received private medical care.

The difficulties in conducting large scale community based surveys for hypertension and stroke in a country whose population is over 600 million people, are discussed at length elsewhere. The present data, therefore, do not represent the epidemiology of strokes in the community, nor do they denote the population at risk.
Nonetheless, the studies as conducted by the same investigators at the same centers have revealed some interesting information on morbidity and mortality trends in stroke subjects over the past two decades. The "referral-bias" and the "observer-bias" are the common factors at the same centers. One is at a loss to understand the reasons behind this phenomenon. During this period, the clinical acumen of our physicians has not changed and the diagnostic tests (namely, examination of cerebrospinal fluid, biochemical, serological, angiographic and similar tests) have remained the same.

Furthermore, the accuracy of clinical diagnosis has been validated by examination of cerebrospinal fluid, cerebral angiographic tests and CT findings. Among other factors, it appears that intensive general medical care (including the use of anticoagulant drugs, antiplatelet agents, etc) may have contributed in the significant drop in case-fatality rate (32% to 10%) resulting in higher survival (68% to 90%) but with residual disability. However, this calls for research in the epidemiology of strokes in the young as information on similar topics from other sources is at variance with the present report.9)-11) The prevention of recurrent stroke and control of associated risk factors needs greater emphasis.16)

The changing pattern, as noted above, has now posed a major challenge of meeting the immediate needs of stroke survivors and their socio-economic, vocational and occupational rehabilitation in order to reintegrate them back into the mainstream of the community.17)

**Role of CT Scan**

What then is the role of modern machines and the prevailing "CAT Fever" in urban India? At our centers, despite CT availability, spinal fluid examination, biochemical, serological and cerebral angiographic tests still continue to be the primary baseline investigations. Certainly, CT findings have played a reassuring role in the neurological diagnosis, but altered the clinical label in only 15%. CT findings have not modified the length of hospital stay nor the course of stroke illness.

To a clinical neurologist working with community screening programs, as well as at university hospitals, one must submit that the major technological advances made by CT, PET and NMR have improved our understanding of the pathophysiology of cerebral infarct and other conditions (e.g. strokes in tuberculous meningitis) but with the realistic goal of "health for all by 2000 A.D.", it would be more prudent for us to utilise our meager resources (U.S.$335,000 per CT) to upgrade existing urban and rural laboratory and radiologic facilities at Public Health Care Centers. Of course, there is also
a dire need for well trained clinicians to administer the art of healing to a "sick person" as a whole, within the context of community life.

In conclusion, one must admit that most centers in India and Asia are lagging far behind the developed nations in delivering sophisticated medical care. However, at present, except for university training hospitals, it is not possible to afford the cost, nor the "economics" in terms of maintenance, of modern machines like a CT scan. Even for developed countries like the U.S.A., the economics and politics of CT scanners have been major topics of debate. On the other hand, for Asian nations, "integrated community rehabilitation for all" has been the moral issue.

**Recommendations**

On the basis of currently available hospital based information from prospective stroke studies, some general recommendations are desirable:

1. It is essential to initiate a hypertension and stroke registry at all university medical college hospitals, including their associated primary health care centers, with a view toward collecting baseline data on this problem in urban India.

2. When a dependable infrastructure is available in rural areas (e.g., positive health education and vaccination drives, family planning drives, eradication of infectious disease by trained paramedical personnel, etc) it may be possible to obtain some data for rural India.

3. Adequate practical training of available medical and paramedical manpower by organizing symposia or seminars appears mandatory to standardize the nomenclature and approaches on hypertension and stroke control programs. Such programs should stress simple guidelines on the collection of basic data, diagnosis, immediate domiciliary medical care and eventual vocational rehabilitation.

4. Special research teams located at well equipped neuroscience laboratories should devote their time and resources only to the study of etiological and genetic factors as identified in a particular community.

5. Primary health care centers, rather than university hospitals should be the base stations for community screening drives and prevention programs.

**References**

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