Review Article

Stroke in Young in India

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1. Introduction

Stroke in young poses a major health problem. WHO defines stroke as an event caused by the interruption of the blood supply to the brain, usually because a blood vessel bursts or is blocked by a clot. This cuts off the supply of oxygen and nutrients, causing damage to the brain tissue [1]. The most common symptom of a stroke is sudden weakness or numbness of the face, arm, or leg, most often on one side of the body, occurring in 90% of the strokes [2]. Other symptoms include confusion; difficulty speaking or understanding speech; difficulty seeing with one or both eyes; difficulty walking, dizziness, and loss of balance or coordination; severe headache with no known cause; fainting or unconsciousness. The effects of a stroke depend on which part of the brain is injured and how severely it is affected. A very severe stroke can cause sudden death.

Globally, stroke is the third commonest cause of mortality [3] and the fourth leading cause of disease burden [4]. It makes an important contribution to morbidity, mortality, and disability in developed as well as developing countries. In recent years, there has been increasing economic and demographic development in developing countries resulting in a shift from diseases caused by poverty toward chronic, noncommunicable, lifestyle-related diseases [5]. This happening in the younger age group adds to the social burden, and as such these patients merit special attention in diagnostic, therapeutic, and preventive care. It leaves the patients with residual disabilities like physical dependence, cognitive decline, depression, and seizures. The review discusses the burden of stroke in young and its implications in a developing country like India along with an approach to identifying different causes that are known to occur in this age group.

2. What Is So Special about Stroke Occurring in Young?

Age wise segregation of cases in stroke is important due to several reasons. Age has been shown to have a strong association with the incidence of stroke. While the peak age of stroke occurrence is 55–65 years [6], events occurring at a younger age assume importance in being occurring in a productive age group and having a different set of causes which have to be looked into apart from the conventional ones (Tables 1, 2, and 3). They are also different from childhood strokes which have been classified as those occurring in less than fifteen years of age.

Cerebral venous thrombosis and rheumatic heart disease are the leading causes of stroke in the young in India [18]. Tubercular meningitis leading to arteritis or autoimmune angiitis are also important stroke risk factors in young [19, 20]. Other Indian studies that have reported risk factors
Table 1: Causes of stroke in young - Ischemic.

| Cardioembolic | Vasculitis | Others |
|---------------|------------|--------|
| Common | Less common | Common | Less common | Common | Less common |
| Rheumatic heart disease | Patent foramen ovale | Infections | Polymyalgia nodosa | Atherosclerotic vascular disease | MELAS |
| Prosthetic valve | Myxoma and other tumors | Antiphospholipid antibody syndrome [7, 8] | Takayasu’s arteritis | Arterial dissection | Prothrombotic states |
| Atrial fibrillation | Acute myocardial infarction | Systemic lupus erythematosus | Wegener’s granulomatosis | | |
| Bacterial endocarditis | Mitral valve prolapsed | | | | |

Table 2: Causes of stroke in young - Hemorrhagic.

| Common | Less common |
|--------|-------------|
| Arteriovenous malformations | Moya moya syndrome |
| Saccular aneurysms | Arteritis (septic or mycotic) |
| Bleeding disorders | Intracerebral tumors |
| Anticoagulants | Substance abuse like cocaine |

Table 3: Causes of stroke in young - Venous.

| Common | Less common |
|--------|-------------|
| Pregnancy | Prothrombotic states |
| Postpartum | Red blood cell disorders |
| Dehydration | Bechet’s disease |
| Oral contraceptive | Connective tissue disease |
| Other prothrombotic states | |

among the young include coagulopathy, elevated lipoprotein (a), homocysteine, and elevated anticardiolipin antibodies [21–25]. Some Indian studies have reported interesting causes of stroke, like viper envenomation, and also suggested mechanisms like squatting whilst on the toilet as an important triggering factor for stroke in Indians, by raising the blood pressure [26, 27]. A recent study from Pakistan [28] in 50 young stroke patients also found infective meningitis including tuberculous meningitis and bacterial meningitis as the leading cause of stroke (34%). The second most common cause was cardioembolism (20%) comprising Valvular heart diseases (14%), Cardiomyopathies (4%), and atrial myxoma (2%). Hypertension was found in 14% cases. Pregnancy-related causes (including Pregnancy-induced hypertension and puerperal sepsis) were 12%. Systemic lupus erythematosus and nephritic syndrome was 4% each. Various causes which constitute 4% or less were grouped together as miscellaneous and they include hyperhomocysteinaemia and hyperlipidaemias.

While the data from several studies worldwide in young stroke population have realized that conventional risk factors for all strokes still are most prevailing in young strokes as well and while more than a decade-old Baltimore Washington [29] study found cardiac embolism (31.1%), hematologic and other (19.8%) small vessel (lacunar) disease (19.8%), nonatherosclerotic vasculopathy (11.3%), illicit drug use (9.4%), oral contraceptive use (5.2%), large artery atherosclerotic disease (3.8%), and migraine (1.4%) in their 428 young ischemic stroke patients, a later case series from Rome [30] confirmed smoking in 56% of patients, hypertension in 23%, dyslipidemia in 15%, migraine in 26%, and diabetes mellitus in 2% in 394 young ischemic stroke patients. Diabetes, hypertension, heart disease, current smoking, and long-term heavy alcohol consumption are major risk factors for stroke in young adults as in older population [31].

Data on primary intracerebral hemorrhage (ICH) in young is scarce in India. Mehndiratta et al. [32] found
**Table 4: Studies on stroke conducted in India.**

| Study | Setting | Results | Comments |
|-------|---------|---------|----------|
| Abraham et al. [48], 1970, Vellore | Rural and urban, community-based, all stroke prevalence | Prevalence: 56.9/100,000 | 25% of the stroke patients were below the age of 40 years. |
| Bansal et al. [49], 1975, Rohtak | Urban, community-based study, all stroke prevalence | Population: 79,046 Prevalence: 44/100,000 | |
| GourieDevi et al. [50], 1987, Karnataka | Rural, community based study, all stroke prevalence | Population: 57,660 Prevalence: 52/100,000 | |
| Razdan et al. [37], 1989, Kashmir | Rural, community based study, all stroke prevalence | Population: 63,645 Prevalence: 143/100,000 | 10.9% of age group 15–39 years (prevalence rate 41/100,000) |
| Dalal et al. [51], 1989, Mumbai | Urban, hospital based study, 1963–1968 and 1978–1982 | Case fatality rate changed from 32 to 12% over this period | Studied only young stroke |
| Nayak et al. [52], 1997, Kerela | Hospital based, retrospective, 15–45 years of age | 177 patients from 1988 to 1994. | Studied clinical features and risk factors in young |
| Mumbai stroke registry [53] | Population based, urban, Jan to Dec 2005, all age groups | Population: 1,86,000 Crude incidence rate: 148/100,000 | 77% ischemic, hypertension in 25.3% |
| JIPMER stroke registry [53] | Hospital based, 2005, all age groups | 105 in six months | 36.2% patients <40 years of age |
| Trivendrum stroke registry [53] | Population-based, urban and rural, 2005, all age groups | Population: 925,867 Crude incidence rate: 97.9/100,000 urban, 81.3/100,000 rural | Stroke in young 4.3% |
| Das et al. [36], 2007, Kolkata | Population based, urban, 2003–2005, all age groups | Population: 52,377 Annual incidence rate (AIR) 123/100,000/year | AIR in <40 years 4.22/100,000/year |
| Lipska et al. [41], 2007, Kerala | Case control study, 15–45 years, ischemic stroke | 214 cases, 195 controls, | Metabolic syndrome and smoking-associated ischemic stroke in young |
| Dalal et al. [54], 2008, Mumbai | Population based study, all stroke types, Jan 2005–Dec 2006 | Population: 156,861 Annual incidence 145/100,000 in >25 years of age | |
| Nagaraja et al. [55], 2009, Bangalore | Hospital based, all stroke types | 1174 patients | 18% less than 40 years of age |
| S. Kaul et al. [56], 2009, Hyderabad | Hospital based, 2001–2005, all stroke types | Annual incidence of stroke 145/100,000 | 10–15% of stroke in young |

ICH in their 18 (14.2%) of 127 young stroke patients. Most common etiology was ruptured aneurysm (44.4%) followed by ruptured Arteriovenous Malformations (AVM) and hypertension (22.2% each) and eclampsia in 11.1%. Causes of ICH in young in other parts of the world have yielded variable results. The Hemorrhagic Stroke Project (HSP) [33] had 217 out of 1714 patients with primary ICH. The independent risk factors found were hypertension, diabetes, menopause, current cigarette smoking, alcoholic drinks > or =2/day, caffeinated drinks > or =5/day, and caffeine in drugs.

### 3. Why Its Identification Is Important in Developing Countries Like India?

By 2050, it is anticipated that 80% of stroke events will occur in people living in developing regions of the world [34, 35]. Interestingly, the Kolkata study sample consisted of mainly younger people (>80% were aged <60 years) who are active in the workforce. When stroke occurs in the main income earner in the household, there may be enormous consequences for the welfare of the family [36]. Indian studies have shown that about 10% to 15% of strokes occur in people below the age of 40 years [37]. It is believed that the average age of patients with stroke in developing countries is 15 years younger than that in developed countries [38, 39]. In India, nearly one-fifth of patients with first ever strokes admitted to hospitals are aged <40 years [40]. However, in the Trivandrum Stroke Registry [41], only 3.8% of incident strokes occurred in people aged <40 years, 9.5% aged <50 years, and 18.1% aged <55 years; these data are very similar to that in another community-based study from northeastern India [36] and those from developed countries [42]. The reported occurrence of stroke in the young, therefore, appears to be largely an artifact related to hospital-based case ascertainment [43].
4. What Information Do We Have So Far about Stroke in Young in India?

Literature is available suggesting that risk of coronary artery disease (CAD) is higher in Indians especially in the young population [44, 45]. While we know that the risk factors for stroke and coronary artery disease are same, recent studies show that the risk of stroke may be comparable to other populations [46, 47]. A number of well-designed prevalence studies of stroke were carried out in hospital and community in various parts of the country in the past and recently, which have not only looked at risk factors but also focused upon the young stroke population [41]. Table 4 shows the studies conducted in various parts of India.

While these studies do reflect the enthusiasm of neurologists and stroke specialists in India to acquire knowledge about stroke in young and stroke at large, the wider implications in a developing country are unique to this geographic area.

5. What Information Is Still Needed from Studies?

More robust evidence is still required to dispel the myth that young Indians are more susceptible to stroke [65]. The areas which require more information and insights are intracerebral hemorrhage, cerebral venous sinus thrombosis in young apart from ischemic stroke which forms the majority and also the focus of stroke studies. Not only this, the less conventional risk factors like migraine [16] and patent foramen ovale [66], emerging factors like arterial dissection [67], and established but less studied causes like peripartum [68, 69] and infection [70, 71] need greater evidence from India as well.

6. Limitations of the Review

As mentioned, definite answers are still required to answer whether young Indians have increased susceptibility to stroke. Most of the studies have a heterogeneous population are hospital-based data with admission and selection bias. Future studies should aim for a multicentric well-defined prospective evaluation on representative population samples to acquire robust answers.

7. Conclusion

While it might turn out through more evidence that stroke in young Indians might not be very different from that in other countries, the implications in a developing country are many. Preventive measures could aid immensely in bringing down costs and emotional burden on the family. But this would need prior and correct identification of burden and risk factors prevailing in the community. Of added interest would be risk factors, both acquired and genetic, which are unique to this geographic area.

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