STROKES IN THAI CHILDREN : ETIOLOGY AND OUTCOME

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Abstract. In Asian countries, specific etiology and outcome of stroke in children are rarely reported. During January 1979 to December 1997, 68 children with stroke, admitted to the Department of Pediatrics, Ramathibodi Hospital, Bangkok were reviewed for etiology and outcome; 38 patients (22 males) had ischemic stroke and 30 (20 males) had hemorrhagic stroke. Severe headache, vomiting, disturbance of consciousness and papilledema were prominent presentations of hemorrhagic stroke. Bleeding from vascular anomalies of the brain (AVM) was the most common etiology of hemorrhagic stroke while septic and non-septic emboli from congenital and acquired heart diseases were the most common cause of ischemic stroke. The mortality rate was 7% and 9% in hemorrhagic and ischemic strokes, respectively. Complete recovery was observed in 52% of cases of hemorrhagic stroke but in only 26% of ischemic stroke. Hemiparesis was the most common residual neurological deficit with higher occurrence in ischemic stroke.

INTRODUCTION

In infants, as much as 40% of the cardiac output is directed toward the cerebral circulation. Any interruption of the flow will rapidly compromise cerebral metabolism and lead to irreversible brain damage (Golden, 1985).

Although stroke is not a common problem in pediatrics and the specific etiology of stroke is infrequently determined in children. However, a thorough search for causes is necessary for providing specific therapeutic intervention and/or prevention of recurrence (Devilat *et al,* 1993; Israels and Seshia, 1987; Pearl 1987; Riikonen *et al,* 1994).

Childhood stroke has been documented in hospitalized and autopsy series, mainly from western countries (Eeg-Olofsson and Ringheim 1983; Lanska *et al,* 1991; Pavlakis *et al,* 1991; Riela and Riela, 1993). In Southeast Asian countries, the data, especially concerning the etiology or outcome, are sparse. This study describes the etiology and outcome of 68 children with stroke admitted to the Department of Pediatrics, Ramathibodi Hospital, Bangkok, Thailand.

MATERIALS AND METHODS

The medical records of children under 15 years of age with the diagnosis of stroke admitted from January 1979 to December 1991 were reviewed for etiology and outcome. The diagnosis of stroke was made on the basis of sudden occurrence of a focal neurological deficit with the evidence of intraparenchymal cerebral hemorrhage or ischemic changes demonstrated by angiography, computed tomography (CT) or magnetic resonance imaging (MRI) of the brain.

The laboratory tests including CBC, urinalysis, serum electrolytes, sugar, BUN, creatinine, liver chemistries, lipid profile and laboratory screening for collagen diseases were reviewed. Patients whose stroke was related to birth trauma, intracranial infections, postnatal trauma or following seizures were excluded from the study. Patients who were lost to follow up after discharge from the hospital were not included in the outcome evaluation.

RESULTS

During January 1979 to December 1991, among the total admission of 41,070 children at the Department of Pediatrics, Ramathibodi Hospital, sixty-eight of them fulfilled the criteria for the study. Their ages ranged from 6 months to 15 years old. Yearly prevalences were calculated and ranged from 0.3-3.4 per 1,000 admissions with a mean of 1.5 per 1,000 per year. Sixty-one patients were followed up for a median of 3.5 years (range from 1-13 years) and seven patients were lost to follow up after discharge from the hospital.

Of the 68 patients, 30 patients (44%) had hemorrhagic stroke and 38 (56%) had ischemic stroke. The sex distribution was 20 males and 10 females for hemorrhagic stroke, 22 males and 16 females for ischemic stroke. The distribution of age at onset of each type of stroke was shown in Table 1 and the signs and symptoms in Table 2. The major difference of signs and symptoms between the two groups of stroke included severe headache on admission, frequent vomiting, disturbance of consciousness and papilledema which were the prominent presentations of hemorrhagic stroke, while unilateral neurological signs corresponded to disturbance of vascular supply to certain part of the brain was the predominant finding in ischemic stroke.

The predisposing conditions leading to hemorrhagic stroke in the 30 patients are shown in Table 3. Primary vascular anomalies were the most common predisposing factor. Arteriovenous malformation (AVM) was found in 12 patients; other vascular anomalies included angioma and various types of aneurysms in 5 patients. Coagulation defects were the cause of bleeding in 6 patients and hypertensive hemorrhage in 3 patients.

In ischemic stroke the predisposing conditions could be identified in 22 patients (58%) (Table 4). Septic and non septic emboli from congenital and acquired heart diseases were the most common factors (31.6%). Underlying vascular diseases, *eg* moyamoya disease, AVM, Takayasu's arteritis and migraine headache, were found in 26.4%.

There were no abnormal laboratory findings regarding CBC, UA, serum electrolytes, sugar, BUN, creatinine, liver chemistries, lipid profile and screening for collagen diseases. Natural anticoagulants *ie* protein C, protein S and antithrombin III were determined in 8 of the 38 patients with idiopathic ischemic stroke and were within normal limits in all patients tested.

All patients received appropriate supportive and symptomatic treatment. In hemorrhagic stroke, craniotomy to remove the hematoma was performed in 9 patients. Anticoagulants were not given to any of the ischemic stroke patients.

Table 1

Age at onset of strokes.

Age at onset (yrs)	Hemorrhagic	Ischmic	Total
1/2-5	8	15	23
5-10	10	8	18
10-15	12	15	27
Total	30	38	68

Table 2

Symptoms and signs on admission.

Symptoms and signs	Hemorrhagic stroke		Ischemic stroke	
	No.	%	No.	%
Headache	23	77	12	32
Vomiting	17	57	2	5
Disturbances of consciousness	19	63	15	39
Abnormal fundi	9	30	3	8
Unilateral neurological signs	17	57	37	97

The mortality rate related to stroke and its complications was 7% and 9% in hemorrhagic and ischemic strokes, respectively. Complete recovery was observed in 52% cases of hemorrhagic stroke but only 26% cases of ischemic stroke. Recovery of neurological functions, was rapid within 3 weeks in several children, however, none was fully recovered by the time of hospital discharge. Those who had major functional deficits at the time of hospital discharge usually did not have substantial functional recovery in the long term. Residual disability was observed in 41% and 62% in hemorrhagic and ischemic strokes, respectively, after 1-13 years of follow up. More detailed information concerning residual deficits is shown in Table 5. Hemiparesis was the most common residual disability in both groups.

DISCUSSION

The incidences of hemorrhagic and ischemic strokes in children under 15 years of age have been reported to be 2.1 and 2.52 cases per 100,000 per year, respectively (Eeg-Olofsson and Ringheim, 1983; Schoenberg *et al,* 1978). These incidences are about one to one-half the rate of primary intracranial neoplasms, one of the leading causes of death in the pediatric population in the United States (Schoenberg *et al,* 1976). The prevalence of the disease (excluding those associated with birth or postnatal trauma, infection of the CNS and following seizures) as observed in this study of 1.5 per 1,000 admission per year. Thus, the magnitude of childhood stroke in Thailand may be greater than previously realized. This may be even more important after considering the quality of survival of these patients: although they may survive after the acute event, many of them are left with residual disability.

The presentation of stroke in children is typically an abrupt neurological deficit, usually acute hemiparesis (Golden, 1985). In the present series, most patients with hemorrhagic stroke presented abruptly although in some patients it took some time before full neurological deficit developed. In ischemic stroke, occasionally the onset occurred abruptly but mostly they developed in a stepwise fashion over hours or days. There are no reliable clinical signs to fully differentiate the two types of stroke. However, severe headaches, vomiting, disturbance of consciousness and papilledema were markedly more frequently observed in hemorrhagic stroke. Although unilateral neurological signs were more common in ischemic stroke they were also quite frequently observed in the hemorrhagic group.

Table 3

Predisposing conditions of hemorrhagic stroke.

Predisposing conditions		No.
Vascular anomalies		18
AVM	12	
Angioma	1	
Mycotic aneurysm	3	
Berry aneurysm	1	
SLE (fusiform aneurysm)	1	
Bleeding disorders		6
Hemophilia A	4	
Hemophilia B	1	
Aplastic anemia	1	
Hypertension		3
SLE	1	
Renal artery stenosis	1	
Beta thal/E disease	1	
Unknown causes		3

Table 4

Predisposing conditions of ischemic stroke.

Predisposing conditions		No.	%
Cardiac anomalies		12	31.6
CHD	8		
Cardiomyopathy	2		
RHD	1		
MVP	1		
Vascular anomalies		10	26.4
Moyamoya	4		
AVM	2		
Migraine	2		
Takayasu's	1		
Vasculitis (SLE)	1		
Undetermined		16	42

CHD = Congenital heart disease
RHD = Rheumatic heart disease
MVP = Mitral valves prolapse

Table 5

Morbidity and mortality.

Outcome	Hemorrhagic stroke No. (%)		Ischemic stroke No. (%)	
Complete recovery	14 (52)		10 (29)	
Residual disabilities	11 (41)		21 (62)	
Hemiparesis	8		19	
-mild	4		12	
-moderate	2		4	
-severe	2		3	
Hemianopsia	1		2	
Dysphagia	2		3	
Seizures	2		2	
Death	2 (7)		3 (9)	
Total	27		34	

More than half of the children with ischemic stroke had cardiac or vascular anormalies as the two main predisposing conditions causing embolism or thrombosis. Arteriovenous malformation (AVM) was found in two patients of this group and it was likely that this contributed to the ischemic episodes.

Forty-two per cent of patients with ischemic stroke had been in excellent health before the episodes. Although infectious diseases, especially viral, are known to be a triggering factor for vascular pathology leading to a thrombotic process in children (Eeg-Olofsson and Ringheim, 1983; Solomon *et al,* 1970), in this group of patients no evidence of preceding viral infection was noted. Deficiency of natural anticoagulants (protein C, protein S, antithrombin III or antiphospholipid) was reported to be one of the causes of childhood ischemic stroke (Coull *et al,* 1992; Israels and Seshia, 1987). During the past 2 years, screening for protein C, protein S and antithrombin III was carried out in 8 of the ischemic stroke patients without obvious predisposing condition and no abnormality was found.

In most series, children with ischemic stroke had better survival rates but of those surviving the initial stroke, patients with hemorrhagic stroke had less residual disability (Schoenberg *et al,* 1978). In this series, there was no substantial difference in mortality between the two groups. Most patients regained some motor function after the episodes but in some cases, severe functional disability persisted. Tibbles and Brown (1975) reported 28 patients with acute hemiplegia of childhood. Twenty-one (75%) of them had a persistent motor handicap at subsequent examination. Solomon *et al* (1970) studied 41 children with acute hemiplegia and 30 (78%) of them had a residual motor deficit (Solomon *et al,* 1970). In a population based study of strokes unrelated to birth, intracranial infections or trauma, Schoenberg *et al* (1978) found that 31 of 34 survivors of ischemic stroke and 4 to 24 survivors of hemorrhagic stroke had a persistent hemiparesis.

The incidence of late seizures following childhood strokes was reported to vary from 11-49% (Yang *et al,* 1995). In this groups of patients the occurrence was 6%. The variation in various studies possibly reflects the different criteria in patient selection and different duration of follow up.

Two patients with migraine were included in this group of patients. Although there is no apparent primary cerebral pathology in migraine, the brain can be damaged by infarction following an unusually severe attack. However, it is a diagnosis which requires exclusion of other disorders (Spaccavento and Sdomon, 1984; Rossi *et al,* 1990).

Brain edema remains the major problem of childhood stroke which can cause brain damage and permanent neurological deficit; prompt and appropriate treatment is required to prevent the deficit. In some patients stroke is preventable if the underlying predisposing factor is recognized and treated early.

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