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Pediatric Stroke: Prevalence, Types, Clinical Presentation, Risk Factors and Outcome in Yemen

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Abstract

➢ ***Background:***
Stroke is a common health problem in the pediatric population. There was no information about the pediatric stroke in Yemen.

➢ ***Objectives:***
To assess the prevalence, types, clinical presentation, risk factors and outcome of stroke in the Yemeni pediatric population.

➢ ***Method:***
The study was a prospective cross-sectional descriptive hospital-based study. It was conducted at the department of pediatrics in AL-Thawra Teaching hospital in Sana'a from January 2010 to December 2013. Children with ages from 1 month -15 years presented with manifestations that suggests the diagnosis of stroke were eligible for enrollment. The data were collected and analyzed by using Statistical package for the social sciences (SPSS) version 20.

➢ ***Results:***
It was found that the annual incidence rate of stroke was 55.8/100000 children. The mean age was 74month (range, 2 -162 months) and the peak age was below the first year. Males were 62.5% while females were 37.5%. Most of the patients were from rural areas (62.5%). Twenty seven of the cases (67.5%) had ischemic stroke, out of them 88.8% were arterial ischemic stroke, and 11.2% cerebral sinovenouse thrombosis, while thirteen of cases (32.5%) had hemorrhagic stroke and males were a predominant in both types. Children who had stroke divided into two age groups, group I (<24months) and group II (≥24 months), in both age groups the males were predominant. The ischemic stroke was higher in age group I (90%) while the hemorrhagic type was higher in group II (40%). The most common clinical presentation was motor deficit 29 (72.5%) cases, followed by, seizure 21(52%), coma 20 (50%), headache 15(37.5%), cranial palsy 11(27.5%), and aphasia and vomiting 10 (25%) for each. Focal deficit was common in ischemic stroke (81.5%) and headache in hemorrhagic stroke (61.8%). Hematological diseases(32.5%) were the most common risk factors of stroke in children and were common in hemorrhagic stroke(69.2%), followed by cardiac diseases(27.5%) which were common in ischemic stroke (37%) . The outcome was death in 20% of cases, 30% had neurological complications and 25% improved. The recurrence rate of stroke is (10%).

➢ ***Conclusion:***
Pediatric stroke is common in Yemen with infant's young than 2 years and males were more affected. The ischemic type is predominant, focal deficit; seizure and coma were the commonest clinical presentation. Hematological and cardiac diseases were the common risk factors. The mortality rate as well as the neurological squeal was high.

Keywords:- *Yemen, Prevalence, Hemorrhagic stroke, Ischemic stroke, Clinical manifestations, Risk factors, Outcome, Stroke.*

I. INTRODUCTION

Pediatric stroke is a foremost reason of ultimate disability and mortality among children [1]. It is a clinical syndrome described according to the World health organization (WHO), by swiftly emergent signs of focal or global disturbance of cerebral functions, for more than 24 hours or leading to death, with no perceptible etiology other than of vascular origin [2]. The two main forms of pediatric stroke are arterial ischemic stroke (AIS) and cerebral sinovenous thrombosis (CSVT), which are due to vascular occlusion. Vascular rupture leads to hemorrhagic stroke [3]. In developed countries, the reported incidence of stroke in children over one month of age range from 1.2-8/100000/year[4, 5]. However, higher incidence reported, in Raidyh and was 27/100,000[6]. In Baghdad the incidence was 54.2/100,000 [7]. There was no information about the stroke in children in Yemen and this is the first study that describes pediatric stroke.

II. MATERIALS AND METHODS

This was a hospital based prospective cross-sectional descriptive study performed at Al-Thawra Teaching Hospital, a tertiary referral hospital in Yemen. This study was carried for a period of four years, from January 2010 to December 2013. The study recruited all Yemeni children from one month up to fifteen years of age admitted to the pediatric ward with clinical diagnosis of stroke confirmed by brain neuroimaging were enrolled in the study. Non Yemeni children below 1 month and above 15 years and with same clinical presentation of stroke other than stroke were excluded in this study. A complete pre-designed questionnaire including (age, sex, resident, full medical

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history, physical examination, neuroimaging and laboratory investigation) was filled for each patient. A wide range of investigations were done for the patients to find out the causes of their stroke. These investigations include neuro-imaging(brain computed tomography (CT) or magnetic resonance imaging (MRI) and baseline laboratory studies (complete blood count (CBC) , blood sedimentation rate (ESR) and/or C- reactive protein , a prothrombin time (PT), activated partial thromboplastin time (APPT)). Other diagnostic investigations were done according to the patient's condition such as analysis of the cerebrospinal fluid (CSF), echocardiogram, hemoglobin electrophoresis, antinuclear antibodies (ANA), anticardiolipid antibodies, lipid profile, magnetic resonance angiography (MRA). The data were analyzed using Statistical package for the social sciences (SPSS) version 20. Pearson's chi-square test was used for categorical variables and student's test for continuous variables. The P value <0.05 was considered significant. Ethical review was done by the Research Ethics of faculty of medicine and health sciences in Sana'a University.

III. RESULT

During the study period of four years, 17926 of children were admitted to the hospital of them 40 children who fulfill the inclusion criteria of clinical diagnosis of stroke were enrolled in this study. The annual incidence of stroke was 55.8/100,000 children. Their mean age was 74 (±54) months with a range of 2 to 162 months. The peak age of the stroke was below the first year of life (25%). Males were 62.5% while females were 37.5% with the male to female ratio 1.7:1. Most of those patients were from rural areas 25(62.5%). Regarding the type of stroke 27 cases (67.5%) were ischemic (88.8% was an arterial ischemic stroke and 11.2% venous thrombosis) and 13 cases (32.5%) were hemorrhagic. Weakness as hemiparesis was the commonest feature 29 cases (72.5%), followed by convulsion 21(52.5%), coma 20(50%), headache15 (37.5%), cranial nerve affection 11(27.5%) and vomiting and speech disturbance 10(25%) for each. Regarding to the risk factors of stroke we found that hematological diseases were the commonest risk factor 13 (32.5%)cases of them [10 (25%) cases had bleeding tendency and thrombosis in 3(7.5%)]. The cardiac diseases were the second risk factor and were 11(27.5%)cases of them 8 (20%) cases were congenital heart diseases and 3(7.5%) were infective endocarditis. The other risk factors were infectious diseases, vasculitis and systemic diseases were 6(20%), 4(10%) and 3(7.5%) cases respectively. Unknown risk factor was present in one (2.5%) case. The outcome of stroke in this study was 10 (25%) cases were improved, 12 (30%) cases developed neurological complications, 8(20%) cases were died and 10(25%) cases were discharged against medical advice. The neurological deficit include 8 (20%) cases had motor deficit as hemiparesis, 2(5%) cases had a seizure, and speech disturbance and vision loss were present in 1(2.5%) case for each. Recurrence rate was 4 cases (10%) [Table 1].

Table (2) demonstrates the clinical profile of children according to the type of stroke. The mean age of ischemic stroke was 67(±56) months while in hemorrhagic stroke was 89(±46) months but there was no statistically significant difference (p-value =0.2). There was a male predominance in both type of stroke. The ischemic and hemorrhagic types in male were 63% and 61.5% respectively ,but in female were 37% and 38.5% respectively and the difference was not statically significant(p value=0.5) . Weakness was higher in ischemic stroke 22 (81.5%) cases than hemorrhagic type 7 (53.8%) cases and the difference was statically significant (p-value= 0.04). On the other hand, headache was higher in hemorrhagic stroke 7cases (61.5%) than ischemic type 7cases (25.9%) and the difference was statically significant (p-value=0.02). The recurrence of stroke in the ischemic type was higher (11%) than hemorrhagic type (8%), but the difference was not statically significantly (p-value=0.6).

In this study, the children who had stroked divided into two age groups. The first age group (group I) was below24 months and include 10 cases (25%), the second age group (group II) was ≥24 months old and represented 30 cases (75%). Table (3) summarizes the clinical profile of children according to the age group. In both age groups males with stroke were affected more than females and were 7(70%) cases and 18(60%) cases respectively, and the differences was not statistically significant (p value =0.5).The ischemic stroke was higher in group I (90%) than in group II (60%), while the hemorrhagic type was higher in group II (40%) than in group I (10%) and this difference was statistically significant (p-value=0.04). Regarding to the clinical presentation, weakness, headache and speech disturbance were common in age group II [83%,50%, and 33% respectively] than in age group I [40%,0%, and 0% respectively] and these differences were statistically significant (p-value=0.007,0.001 and 0.01 respectively). The recurrence of stroke was 10% in both age groups and this difference was not statistically significant (p-value =0.4).

The risk factors and outcome of stroke according to the type of stroke show in Table (4). The hematological diseases were the most common risk factors in hemorrhagic stroke and present in 9 (69.2%) cases but in ischemic stroke present in 4 (14.8%) cases, these differences were statistically significant (p-value 0.001). The cardiac diseases were common in ischemic stroke and present in 10 (37%) cases but in hemorrhagic stroke present in 1 (7.7%) cases, these differences were statistically significant (p-value 0.05). Regarding to the outcome, the motor deficit was found in (23.1%) in hemorrhagic stroke and 18.5% in ischemic type and this difference was not statistically significant (p-value=0.5). Seizure and speech disturbance were occurred only in ischemic stroke [7.4% and 3.7%, respectively] but this difference was not statistically significant (p-value was 0.3 and 0.5 respectively). The improved cases in ischemic stroke were (25.9%) and was higher than the hemorrhagic stroke (23.1%) but these difference was no statistically significant (p-value=0.8). The death cases were common in hemorrhagic stroke

(23.1%) than ischemic type (18.5%), and these difference was no statistically significant (p-value=0.7).

IV. DISCUSSION

Pediatric stroke is becoming increasingly recognized as an important cause of morbidity and disability in childhood. The annual incidence of stroke In North America and Europe was reported in about 2 to 13/100,000 children, in Asia, 1.9 to 2.1 cases per 100,000 children[8] and in Hong Kong, 2.1/100,000 children[9]. Salih et al has been reported that the calculated annual frequency rate was 27.1/100,000 of pediatric (1month-12years) populations [6]. In our study the calculated annual was 55.8/100,000 children and this was agreement with study reported that the annual frequency rate was 54.2/100,000 children[7].The reasons for increased incidence were related to the fact that Al-Thawra hospital is one of the 3 main hospital in Sana'a city serves as a secondary and tertiary care center which received the patient from other governorates, most of our cases were from rural areas that lack an essential health service for dealing with stroke patients as well as neglecting and delayed in diagnosis and management of risk factors of stroke such as cardiac diseases and sickle cell anemia .

The peak age of onset of stroke in the current study was less than one year (25%). This was in agreement with other studies [6, 7] and this could be due to the fact that the infants more prone to dehydration and infection as well as a high percentage of unrepaired congenital heart diseases that are considered risk factors for stroke.

There was a male predominance among our patients and the male to female ratio was 1.7:1 and this in agreement with other study [10]. The male predilection was enigmatic in most of the studies, but it was suggested that it might be related to the behavioral differences that predispose boys to trauma and arterial dissection, and also through genetic x-linked disorders that have been implicated as risk factors [11]. Also it was found that the male child's risk for AIS or cerebral sinovenous thrombosis is connected to androgenic availability[12].In contrast to our study, Christerson & strömberge, found that female predominance than male in their series in 55% as their cases include higher age group that extend up to 18 years[1]. On the other hand, other studies found no gender differences [13, 14]. Regarding the correlations between gender and age groups, our study found that childhood stroke affected males more than females in both age groups and this finding is similar to those in an international cohort study [11]. Most of our cases were from rural areas (62.5%).In contrast to our study, Saadi & Yassin found 44 (63.8%) of their cases were from urban area [7].

In this study, ischemic stroke was more common (67.5%) than hemorrhagic stroke (32.5%), this is similar to many studies [10, 15, 16]. This tendency toward ischemic type in this study might be explained by the high percentage of cardioembolic strokes. The decrease in the number of children with hemorrhagic type of stroke could be due to the exclusion of the cases with hemorrhage due to brain tumors and trauma. In contrast to our study, Narong et al, found that, hemorrhagic stroke was higher than ischemic stroke [17] and Fullerton et al, reported an equal distribution between each type of strokes [18]. Regarding the type of stroke, the present study found that males dominated girls in both ischemic type (63.0%) and hemorrhagic type (61.5%). This is in agreement with other studies reported the dominance of male in ischemic stroke than hemorrhagic stroke [7, 17, 18, 19]. On the other hand, another study found that females predominate in both types of stroke [3]. In this study we found that ischemic stroke was predominant in group I (<24month) than hemorrhagic stroke which is more in group II (≥24month), and this is in consistent with other studies [4, 17, 20].In contrast to our study, other study reported that hemorrhagic stroke was more common in infant and this percentage decreased with increasing of the age and there was no explanation of this result [7].

In our study, weakness was the most common presenting symptom in (72.5%) of cases followed by convulsions (52%), disturbed level of consciousness (50%), headache (37.5%) and speech disturbance (25%) of cases. These results were similar to several studies which reported that hemiparesis is the commonest presenting feature with the next most common being seizure and loss of consciousness, [1, 13, 21]. In contrast a study by Saadi and Yasin, found that the seizure was the most frequent presentation followed by disturbed level of consciousness and vomiting [7]. Our study showed that ischemic type of stroke, presented commonly by hemiparesis (81.5%) followed by seizure (55.6%), and this was similar to study done by Soroor et al [22]. In contrast to our study, Chand et al reported that seizures were more common manifestation followed by hemiplegia and they explained their findings by the early presentation of their cases to the hospital [23]. However, Earley et al, found that, seizures are common in both ischemic and hemorrhagic strokes and occur in up to 50% [24]. In this study, the headache was the most common presenting clinical symptoms of hemorrhagic stroke followed by vomiting and this was in accordance with other studies [22].Our study found that weakness, headache and speech difficulty were the most clinical presentations in age group II, while seizures and impaired consciousness were common in younger age groups (group I) and this result was in agreement with other studies[4,7]. Abend et al explained this by the fact that immature brain might be more excitable because of age-related differences in brain receptor composition, number, and distributions that might favor seizure propagation [25].

In this study we found that hematological diseases was the most common risk factors of stroke followed by cardiac diseases and this results were in similar to other study [26]. In contrast to our study, other studies reported that infectious etiologies were the most common risk factors for stroke [27, 28]. The differences in risk factors panel for each study may reflects that etiology of stroke depends on geography, ethnicity, age at presentation and the availability of medical resources[29].

Regarding to the type of stroke, we found that the cardiac causes were common in ischemic stroke (37%) and this result was in agreement with other study [30]. In contrast to our study Maseri and Ammouri have been reported that metabolic disorders were the most common risk factor of ischemic stroke [14]. On the other hand, we found that the hematological causes were common in hemorrhagic stroke (69.2%) and this was in agreement with study reported by Abbas et al who found that the hematological causes were present in 52% of patients in hemorrhagic stroke [31].

The outcome of the stroke in our study showed that (25%) of patient were discharged with complete recovery, and this is nearly in accordance with other study who found that full recovery present in 25–30% of pediatric patients[32]. In contrast to our study Chaitali et al, found that complete recovery were present in 76.5% of patients [10]. In this study 30% of patients had a neurological deficit and 20% died and this was in contrast with study reported by Chaitali et al, who found that 8.82% of patients presented with neurological deficit and 14.7% died [10]. The mortality rate in our study was common in hemorrhagic stroke and present in (23.1 %) of patients and this result was similar to study reported by Chiang and Cheng [33]. In contrast to our study, Lopez-Espejo et. al identified 11.7% and 19.3% of children died during acute and long term follow up after the first episode of acute ischemic stroke [34]. our results may be explained by increase in intracrainal pressure in case of hemorrhagic stroke and hence, more prone to brain herniation and death, also the diagnosis of stroke was considered challenging especially for young patients who presented with subtle and non-specific symptoms that can be attributed to other neurological disorders such as focal seizures and demyelination and consequently number of patients died before diagnosis.

The present study reported the recurrence of stroke was present in 10% of patients which had Myoamyoa, SLE and bleeding tendency and this is similar to the other study [16]. Another study found that the risk of recurrence was high and the causes were cardiac disease, MoyaMoya diseases and genetic thrombophilia [26].

V. CONCLUSION

This study provides clues for other studies of pediatric stroke in Yemeni children. In this study we found that the incidence of stroke among Yemeni children was higher in comparison to other countries. Ischemic stroke was more common than hemorrhagic stroke. Male infants younger than 2 years had a significantly higher risk of stroke. Hemiparesis followed by seizure and altered mental state was the commonest clinical presentation. Hematological diseases followed by cardiac diseases were the main risk factors of stroke. The neurological deficit and death were high among our patients.

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Variable	Number (No.)	Percent (%)
Age (month) (mean ± SD)	74(±54)	
Range	(2-162)	
Gender		
• Male	25	(62.5)
• Female	15	(37.5%)
Age classification		
• Group I(<24 month)	10	(25%)
• Group II(≥ 24month)	30	(75%)
Residence		
• Rural	25	(62.5%)
• Urban	15	(37.5%)
Type of stroke		
• Ischemic	27	(67.5%)
• Hemorrhagic	13	(32.5%)

Symptoms:		
Weakness	29	(72.5%)
Convulsion	21	(52%)
Coma	20	(50%)
Headache	15	(37.5%)
Vomiting	10	(25%)
Speech disturbance	10	(25%)
Cranial nerve affection	11	(27.5%)
Risk factors:		
Hematological diseases • Bleeding tendency • Thrombosis	**13** 10 3	**(32.5%)** (25%) (7.5%)
Cardiac disease • Congenital heart diseases • Infective endocarditis	**11** 8 3	**(27.5%)** (20%) (7.5%)
Infections	8	(20%)
Vasculitis	4	(10%)
Systemic	3	(7.5%)
Unknown	1	(2.5%)
Outcome		
Improved	10	(25%)
Neurological complicated Motor deficit Seizure Speech disturbance Visual loss	**12** 8 2 1 1	**(30%)** (20%) (5%) (2.5%) (2.5%)
Died	8	(20%)
DAMA	10	(25%)
Recurrence	4	(10%)
Total No.	40	(100%)

DAMA=discharge against medical advice

Table 1:- Demographic data of study population with stroke

Variable	**Ischemic stroke Total NO.=27**	**Haemorrhagic stroke Total No.= 13**	**OR (95%CI)**	**P value**
Age (month) (mean ± SD) **Range**	67 (±56) (2-162)	89 (±48) (2-162)		0.2
Gender • Male • Female	17(63%) 10(37%)	8(61.5%) 5(38.5%)	1.1(0.3-4.2)	0.5
Symptoms:				
Weakness	22(81.5%)	7(53.8%)	3.6 (0.8-17)	**0.04***
Convulsion	15(55.6%)	6(46.2%)	0.9 (0.2-3.6)	0.4
Coma	14(51.9%)	6(46.2%)	1.2 (0.3-4.9)	0.4
Headache	7(25.9%)	8(61.5%)	0.2 (0.1-0.9)	**0.02***
Vomiting	5(18.5%)	5(38.5%)	0.4 (0.1-1.7)	0.1
Speech disturbance	9(33.3%)	1(7.7%)	6.0(0.7-53.7)	0.08
Cranial nerve affection	7(25.9%)	4(30.8%)	1.3(0.3-5.5)	0.5
Recurrence	3 (11%)	1 (8%)	1.5 (0.1-42.6)	0.6

Statically difference = P-value ≤ 0.05

Table 2:- Correlation between the type of stroke and clinical profile of children

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Variable	Age group<24MO Total No.=10	Age group ≥ 24MO Total No=30	OR (95%CI)	P-value
Gender				
• Male	7(70%)	18(60%)	0.6 (0.1-3)	0.3
• Female	3(30%)	12(40%)		
Type of stroke				
• Ischemic	9(90%)	18(60%)	0.2 (0.007-1.2)	**0.04***
• Hemorrhagic	1(10%)	12(40%)		
Symptoms:				
Weakness	4(40%)	25(83%)	7 (1.4-38.9)	**0.007***
Convulsion	4(40%)	17(56.7%)	0.5 (0.1-2.2)	0.3
Coma	3(30%)	17(56.7%)	2.9 (0.6-16.6)	0.08
Headache	0(0%)	15(50%)	Undefined (2.3- undefined)	**0.001***
Vomiting	1(10%)	9(30%)	3.7 (0.4-94)	0.1
Speech disturbance	0(0%)	10(33%)	Undefined (1.1- undefined)	**0.01***
Cranial nerve affection	2(20%)	9(30%)	1.7 (0.3-13.6)	0.3
Recurrence	1(10%)	3(10%)	1 (0.1-29)	0.4

Statically difference = P-value ≤ 0.05

Table 3:- Correlation between the age group and clinical profile of children

Variable	Ischemic stroke Total No.= 27	Hemorrhagic stroke Total No.= 13	P-value
Risk factors:			
Cardiac disease	10(37%)	1(7.7%)	**0.05***
Hematological diseases	4(14.8%)	9(69.2%)	**0.001***
Infections	6(22.2%)	2(15.4%)	0.5
Vasculitis	4(14.8)	0(0%)	0.2
Systemic	2(7.4%)	1(7.7%)	0.7
Unknown	1(3.7%)	0(0%)	0.5
Outcome			
Improved	7(25.9%)	3(23.1)	0.8
Neurological complicated	8(29.6%)	4(30.8%)	
Motor deficit	5(18.5%)	3(23.1%)	0.5
Seizure	2(7.4%)	0(0%)	0.3
Speech disturbance	1(3.7%)	0(0%)	0.5
Visual loss	0(0%)	1(7.7%)	0.1
Died	5(18.5%)	3(23.1%)	0.7
DAMA	7(25.7%)	3(23.1%)	0.8

DAMA=discharge against medical advice, Statically difference = P-value ≤ 0.05

Table 4:- Risk factors and outcome according to type of stroke