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FEBRILE CONVULSIONS IN SUDANESE CHILDREN ***

Ahmed El Nur Abdalla* and Abdel Moneim El Seed**
* Department of Paediatrics, Khartoum North Teaching Hospital and ** Department of Paediatrics and Child Health, Faculty of Medicine, University of Khartoum

Abstract Seventy children with febrile convulsions presenting to Khartoum Children's Emergency Hospital in the period December 1981 - April 1982 were studied. The hospital prevalence of febrile convulsions was found to be 1.8%. The mean age was 30.3 months. There was a preponderence of males being about two thirds of total. The mean ages at presentation for males and females were not significantly different. No particular social class was found to have higher representation in children with febrile convulsions. A family history of convulsions was obtained in 51.4% of patients (40% febrile and 11.4% non-febrile). The only laboratory investigation found to be useful was a blood film for malaria parasites. Bronchopneumonia, malaria and upper respiratory tract infections accounted for about two thirds of the associated illnesses.

All findings were conforming with those reported in the literature except for the following points:

1. Male to female ratio was exceptionally high. Though it compared to that of Saudi children, both were higher than those reported in the literature.
2. Higher percentages were also found for prolonged seizures (30%) and multiple seizures (47.2%)
3. The youngest age group 6-12 months contained the highest number of patients
4. Two aspects of febrile convulsions which were particularly investigated in this study were an association of febrile convulsions with birth order and an association of complex febrile seizures with malaria. The former was found to be commoner in first and second born children, whereas the latter did not reach statistical significance.

Key words Convulsions, febrile; Sudan

Febrile convulsions constitute a common paediatric problem. The incidence in previously healthy children has been variably reported to be between 2.5-5%[1,2]. They account for 40% of all first seizures and occur between age 6 months and six years with a peak at 3 years[1-5]. They are commoner in males.

The familial incidence of febrile convulsions suggests an autosomal dominant mode of inheritance with incomplete penetrance[4,6]. Increased abnormal dermatoglyphics in these children and their parents suggest a polygenic mode of inheritance[6].

Febrile convulsions may have to be differentiated from convulsions associated with central nervous system infections, trauma and electrolyte imbalance. Careful history and physical examination help in differentation more than the battery of investigations which were found to have a poor yield[7-9]. Whether to perform lumbar puncture on all or selected patients with febrile convulsions remains controversial[7-11]. Abnormal electroencephalograms do not reliably predict epilepsy[11]. They may remain abnormal a week after the seizure[1]. Other investigations like computerized axial tomography are rarely useful[11].

A febrile seizure may either be simple or complex. A complex seizure is one that is a) lasting more than 15 minutes, b) focal or c) followed by transient or persistent neurological abnormality. Complex seizures constitute one of the three risk factors that predispose children with febrile seizures to subsequent epilepsy. The other two risk factors are family history of epilepsy in a parent or sibling and a pre-existing neurological abnormality. Children with none or one risk factor have a lesser chance of developing subsequent epilepsy (1% as compared to 10% in children with two or more risk factors). However, febrile convulsions are generally benign and self-limiting [11,12].

Febrile convulsions tend to recur. Thirty to forty percent of children who had one febrile seizure and who did not receive prophlactic therapy will

experience a second attack[11-13]. Recurrences do not, by themselves, increase the risk of subsequent epilpsy[1]

The approach of practicing paediatricians towards children with febrile convulsions had not been uniform[14] In recent years a consensus of opinion started to emerge in an attempt to reconcile the diversities[11]. However some aspects of febrile convulsions still continue to generate controversy.

The aim of this study is to see the prevalence of febrile convulsions in hospital patients and to obtain basic information about this condition in Sudanese children.

MATERIAL AND METHODS

All children presenting with febrile convulsions to Khartoum Children's Emergency Hospital (K C E H) in the period December 1981 - April 1982 were included in this study.

For each patient a history was taken a neurological evaluation was performed, and temperature was recorded from the axilla.

The following investigations-directed mainly towards the diagnosis of the febrile illness were done:

1. A blocd film for malaria parasites (when patients were not taking anti-malarial drugs)
2. Blocd and throat swab cutures (where patients were not taking antibiotics)
3. Urine and stools analysis
4. Lumber puncture was done only on suspicion of central nervous system infection. It was not feasible to perform virological studies in our patients.

To determine whether febrile convulsions associated with malaria carried more risk of being complicated, a comparison was made between children with malaria who presented with convulsions and those who convulsed having had other illnesses.

The data was analysed manually and student's t-test was used.

RESULTS

During the study period of the total number of patients admitted to KCEH was 3871, seventy of whom had febrile convulsions. Thus, the hospital incidence rate of the latter was 1.8%

Age distribution: As seen in table I and Fig 1, the incidence peaked at the age group 31-36 months.

TableI:Age distribution of 70 patients with febrile convulsions

Age Group (in months)	Number of Patients	%
6 - 12	14	20 %
13 - 18	11	15.7 %
19 - 24	8	11.4 %
25 - 30	8	11.4 %
31 - 36	12	17.1 %
37 - 42	2	2.9 %
43 - 48	3	4.3 %
49 - 54	2	2.9 %
55 - 60	3	4.3 %
61 - 66	5	7.1 %
67 - 72	2	2.9 %
Total	70	100 %

$\bar{x}$ = 30.3 months
SD = 18.3 months

Sex distribution:

As shown in Table II, febrile convulsions were found to be commoner in males with male to female ratio of 1.6:1 ($P<0.01$).

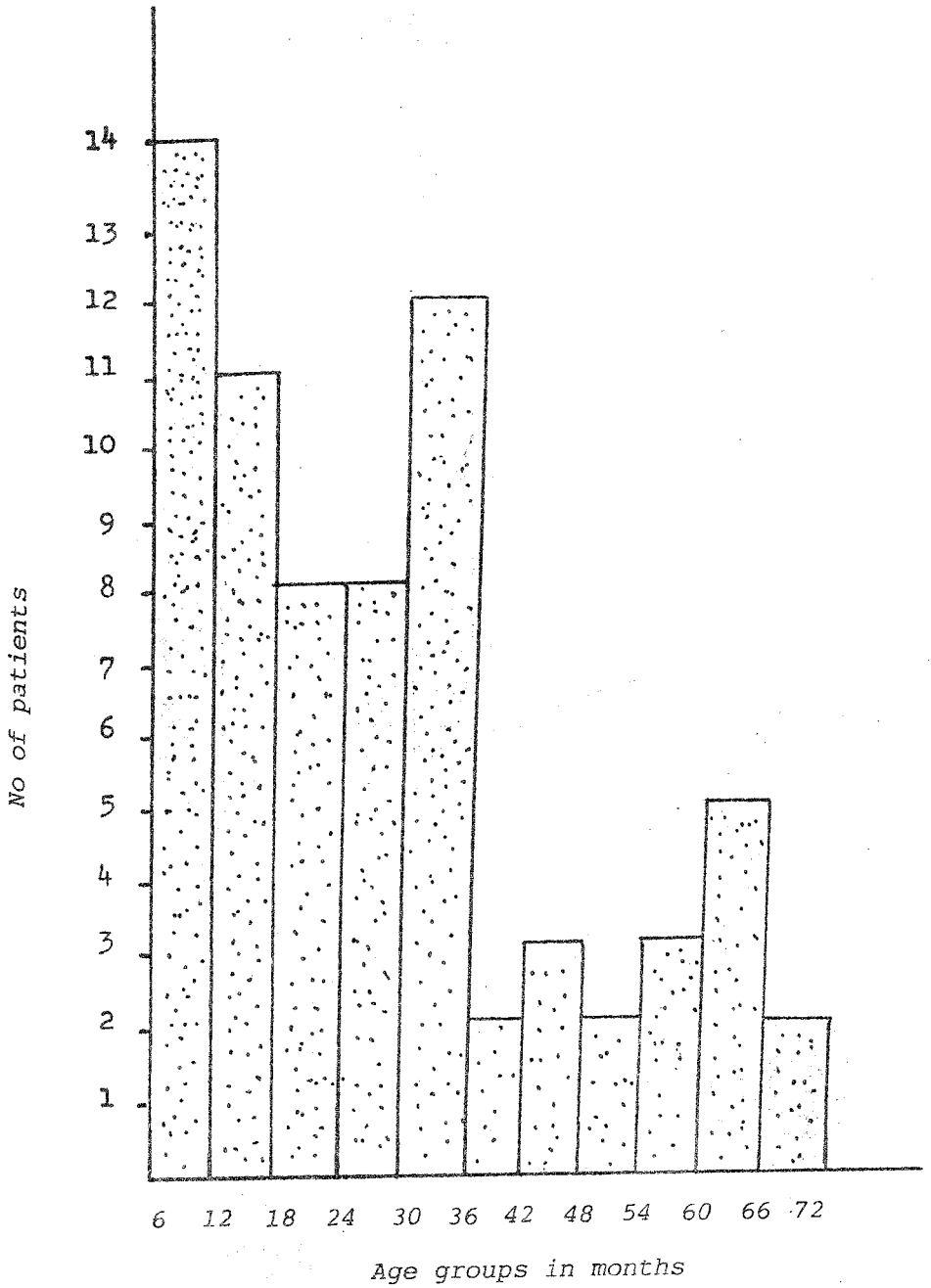

Figure 1 Histogram showing the age distribution of 70 patients

Table II Sex Distribution of Children With Febrile Convulsions

Sex	NO.	%
Males	43	61.4 %
Females	27	38.6 %
Total	70	100 %

Age distribution by sex:

Table III shows the numbers and percentages of males and females with febrile convulsions according to age groups. The mean age for males was 28.4 ± 16.2 months, while that for females 30.9±20.2 months. There was no significant difference between the mean age for males and females.

Table III Age Distribution of Males and Females with Febrile Convulsions

Age group (in months)	Males No.	%	Females No.	%
6 - 12	9	20.93	6	22.22
13 - 18	8	18.60	3	11.11
19 - 24	5	11.62	4	14.81
25 - 30	2	4.65	5	18.51
31 - 36	10	23.25	2	7.4
37 - 42	2	4.65	-	-
43 - 48	2	4.65	1	3.7
49 - 54	1	2.32	1	3.7
55 - 60	2	4.65	1	3.7
61 - 66	2	4.65	3	11.11
67 - 72			1	3.7
Total	43	100%	27	100%

Father's occupation:

Table IV shows the father's occupation of children with febrile convulsions. If we excluded the professionals, who constitute only a small sector of the community, the other classes were almost equally represented with no significant difference between them. However, it's worth mentioning that 54(77.2%) mothers of the patients were illiterate.

Body temperature of Convulsing children at presentation:

Accurate temperature recording could be obtained in 28 out of 37 children who had convulsions on admission.

Table IV : Father's occupation of 70 children with febrile convulsions

Occupation	No.	%
Professional	3	4.2%
Employee	17	24.2%
Small trader	21	30%
Worker	22	31.4%
Unspecified	7	10.2%
Total	70	100%

Table V shows that in 18 (64.3%) of them temperature was found to be more than 39 °C. The mean temperature at presentation was 39.3±0.9 °C. Ten children (35.71%) had temperatures between 39.6-40°C, as shown in the histogram in Fig 2.

Birth Order:

Table VI shows that the highest incidence of febrile convulsions was in first borns (25.7%). When first and second borns were taken together they constituted 44.2% which was significantly higher than any other birth order ($P<0.01$).

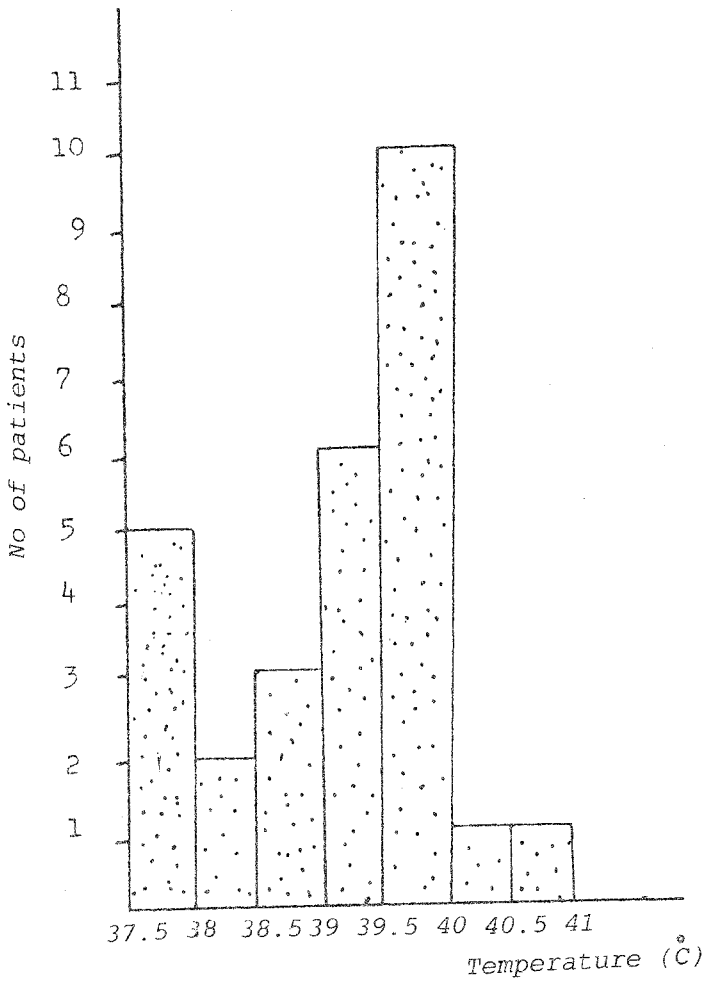

Figure 2 Histogram showing the body tomperature of 28 patients with febrile convulsions

Table V: Body temperature at presentation of children with febrile Convulsions

Temp. (°C)	No.	%
37.5 - 38	5	13.5 %
38.1 - 38.5	2	5.4 %
38.6 - 39	3	8.1 %
39.1 - 39.5	6	16.2 %
39.6 - 40	10	27 %
40.1 - 40.5	1	2.7 %
40.6 - 41	1	2.7 %
Unknown	9	24.3 %
Total	37	100 %

$\bar{x}$ = 39.3°C
SD = 0.9°C

Table VI : Birth order of 70 children with febrile Convulsions

Birth order	No.	%
First	18	25.7 %
Second	13	18.5 %
Third	8	11.4 %
Fourth	9	12.8 %
Fifth	8	11.4 %
Sixth	4	5.7 %
Seventh	5	7.1 %
Eighth	3	4.2 %
Ninth	2	2.8 %
Total	70	100 %

Family history of convulsions:

Thirty six (51.4%) of children with febrile seizures gave a positive family history of convulsions. Of these 28 28(40%) were febrile. The remaining 8 (11.4%) were non-febrile.

Results of investigations:

Blood examination for malaria was done in 49 patients, 148 of whom (28.6%) had positive results. The remaining patients were not tested for malaria because they had been on antimalarial treatment before reporting to hospital. Twenty nine children had a single blood culture done but no organism was isolated. Throat swabs were performed on 6 children who were diagnosed clinically as having tonsilitis but no growth was obtained. Similarly, in 6 children who had diarrhoea, stools examinations were negative. Twenty three children were suspected to have meningitis and a lumbar puncture was done in each case. However, CSF examination revealed no abnormality. Urine examination was done for 15 children and proved to be normal.

Causes of fever:

Table VII shows the causes of fever that could be identified in the 70 children with febrile convulsions. Bronchopneumonia, malaria and upper respiratory tract infections accounted for almost two thirds of the causes of fever.

Duration of fit:

In 49 patients (70%) the fits were brief (Less than 15 minutes) and in 21 patients (30%) were prolonged (more than 15 minutes). The difference between the two was statistically significant ($P < 0.05$).

Type of fit:

In 68 children (97.7%), convulsions were generalized and in only 2 (2.9%) were they focal. The difference was highly significant ($P<0.01$).

Number of fits with the presenting febrile illness:

Thirty three patients (47.2%) had more than one-fit and 32 patients (45.7%) had solitary fits. In 5 patients (7.1%) the number of fits could not be determined.

Past history of febrile convulsions:

Seventy nine patients (27.1%) presented as recurrences (i.e. had past history of febrile convulsions). The remaining 51 patients presented with their first febrile seizure.

Type of fit in children with malaria:

Five (35.7%) of the children with malaria had complex febrile seizures. Of these (28.5%) were prolonged and one (7.1%) was focal. Transient or persistent neurological deficit was not observed in any of these patients.

Table VII: Causes of Fever in Children with febrile convulsions

Disease	No	%
Bronchopneumonia	16	22.9 %
Malaria	14	20 %
U R T I*	13	18.6 %
Tonsillitis	6	8.6 %
Otitis media	1	1.4 %
Gastroenteritis	1	1.4 %
Measles	1	1.4 %
Undetermined	18	25.7 %
Total	70	100 %

* U R T I: Upper respiratory tract infection

Table VIII shows complex febrile seizure in children with malaria and in those with other febrile illnesses. There was no significant difference in the number of complex febrile seizures associated with malaria compared to those associated with other febrile illnesses.

Table VIII: Complex febrile seizures in children with malaria and in those with other febrile illnesses

Febrile illness	No.	Complex seizures	%
Malaria	14	5	35.7 %
Others	56	18	32.1 %
Total	70	23	

DISCUSSION

In this hospital-based study, the incidence of febrile convulsions was found to be 1.8%, whereas in developed countries the incidence ranges between 2.5-5% with an average of 3%[1,2,6]. However, this might not reflect the problem in the community at large. Indeed the known predisposing factors for febrile convulsions such as infections and abnormalities of pregnancy, labour and perinatal period are expected to be more prevalent in Sudan; and enviromental temperature is usually high [1,4,5]. Osuntokun[15] stated that febrile convulsions constitute the commonest childhood emergency in africans.

Nelson and Ellinberg[12] found an incidence of 4.2% in black American children as opposed to 3.5% in white American children. It was not stated whether this difference was racial or due to a difference in the social class.

The mean age for children in this study was 30.3 months. This was higher than a mean age of a group of Saudi children with febrile convulsions (18.6 months), but comprable to a group of American children with febrile convulsions for whom a mean of 23.3 months was reported[12]. Rutter and Smales[8] found a mean of 23.5 months.

When febrile convulsions occur in a child aged less than 18 months, it is likely to be complex[16] and with a higher chance of recurrence[12]. In this series 35.7% of febrile convulsions occured by age 18 months.

children aged 6-12 months occounted for one fifth of of all children which is higher than the number seen in any other age group. This does not agree with earlier reports that the incidence of febrile convulsions declines below 3 years of age[1,4,5]. Febrile convulsions may have an earlier onset in Sudanese children.

A male to female ratio of 1.6:1 was found in this study. This sex ratio-like that reported from Saudi Arabia[5]-is particularly high when compared to that reported from other countries. Ross et al[17] found an insignificant excess of boys, Rutter and Smales[8] found that 58% were males whereas Nellhaus[12] stated that boys appear to be slightly more susceptible than girls.

Sex is found to have a bearing on the prognosis[4,16.18]. Boys with a family history of convulsions have an increased risk of subsequent convulsions with fever but they have a reduced chance of their initial fit being complicated and their long term outlook is generally favourable. The influence of family history on girls is less obvious. A neurolological abnormality preceeding the fit pedisposes to a complex seizure only in females[16]. Girls who have further episods after an initial unilateral fit are likely to have learning difficulties. Females were also reported to have fits earlier than boys[4,6]. In this study there was no statistica - lly significant difference between the mean age at which febrile convulsions occured in males and females.

Ross et al[17] reported the prevalence of febrile convulsions to be the same in all social classes. However, Wallace[19] found that low social class was associated with increased risk of later developing grand mal epilepsy but not psychomotor epilepsy. Apart from the professionals, who represent a small sector of the community, we found no significant difference in the incidence of febrile convulsions in children belonging to the other social classes.

There is no mention in the literature about a relation between febrile convulsions and birth order. However, this study showed that the chances are higher in first and second children in the family ($P<0.01$).

Thirty six (51.1%) children in this study had positive family history of convulsions. Of these 40% were febrile convulsions and 11.1% non-febrile seizures. These are similar to the figures of 40% and 15% quoted by Nellhaus[2] for positive family history of febrile and non-febrile convulsions respectively. Mahdi and Taha[5], reported an incidence of 21% based on a positive family history of epilepsy or febrile convulsion in any relative. This figure is slighly lower than the 26% reported by Rutter and Smales[8]. A history of epilepsy in a parent or sibling is considered to be one of the risk factors[11,12].

The temperature necessary to precipitate a febrile convulsions is around 40°C (104 °F)[6]. Nellhaus[2] stated that most febrile convulsions occur within temperatures above 39°C (102°F). The mean temperature recorded for patients who came convulsing in this study was 39.3°C. It could be inferred that lowering the temperature to below the critical level may, theoretically, prevent or abort a fit. However, one third of children with fever-associated seizures are not recognized as having a febrile illness beforehand[6].

Many workers agreed on the negative feedback from a number of investigations carried out on children with febrile convulsions[5,7-9]. Rutter and Smales[20] found that calcium and magnesim levels in the blood and CSF in children with febrile convulsions were within normal range and the blood CSF ratio were similar to those of normal subjects. Unlike other negative investigations, hyperglycaemia was a frequent finding[20]. Serological investigations were not done for the patients in this study. However, Robinson[6] recommended a routine dextrostix. Mahdi and Taha[5] recommended a routine serum calcium due to the increased prevalence of rickets in their area. Lumber puncture was done in this study only on suspicion of central nervous system infections. This was in line with the recommendations of the National Institute of Health (N I H) Consensus Development Conference on Febrile Convulsions[11]. However, some workers recommend it on all children with febrile convulsions in the absence of facilities for ideal clinical examination and where there is changing staff[7]. Other recommend it on certain circumstances like age below 18 months,

signs of meningitis and in first febrile seizure[9]. Other investigations like skull x-ray and electroencephalogram which were not done in this study were reported to be rarely useful[9,11].

Investigations done to identify the febrile illness may be of help and a blood film examination for malaria parasites is particularly relevant to our setting. Apart from this investigation, all other investigations done on children in this study, including lumber punctures, gave negative results and, therefore, did not add to those obtained from the history and physical examination.

Bronchopneumonia and malaria occounted for about half the cases as causes of fever in this series. When upper respiratory tract infections were added, this constituted about two thirds of cases. Osuntokun[15] stated that in African children 50% of cases of febrile convulsions are due to malaria. In our series these were only 20%. The most commonly reported cause of fever is an upper respiratory tract infection[5,21,21], and the causative agent is frequently viral[6]. In this series virological studies could not be done because of lack of facilities. It's worth mentioning that viral infections tend to precipitate prolonged or complex seizures[4 21].

It would be interesting to know if febrile convulsions due to malaria are particularly liable to be complex. There is no mention in other studies of such a relationship. In this series it was found that the difference between complex seizures associated with malaria compared to those associated with other febrile illnesses was statictically not significant. It might be interesting to recall Osuntokun's[15] statement that 30% of the survivors of all patients with febrile convulsions due to malaria developed seizures or epilepsy, in the absence of fever, within a period of five years.

A large number of children in this series tended to have prolonged seizures compared to what was reported in the literature. While 30% of children in this series had fits lasting more than 15 minutes, the equivalent figures reported by Rutter and Smales[8] and Mahdi and Taha[5] were 15% and 8.3% respectively.

The higher incidence of prolonged febrile seizures in this series has no apparent explanation apart from it being dependent on maternal estimation of the duration of the fit which may be subject to inaccuracy. Fifty four (77.2%) of these mothers were illiterate. Other factors which might have come into play are the high environmental temperature and lack of facilities for fanning. Although there is insufficient epidemiolog - ical or experimental evidence that febrile convulsions cause brain damage[11], every effort should be taken to abort a fit because some workers found significant association between prolonged febrile seizures and temporal lobe epilepsy[19]. In animal studies and in epileptic children who died in status epilepticus, an association between prolonged seizures and mesial temporal sclerosis was reported[6,22]. However, Nelson and Ellinberg[12] found that prolonged duration of a febrile convulsion was not a major determinant of subsequent epilepsy. They added that 90% of children who developed epilepsy after febrile seizures had never had a febrile convulsion that lasted for more than 30 minutes.

Sixty eight (97.1%) of the children in this series had generalized seizures and only 2.9% had focal seizures. This conforms with previous reports that febrile convulsions tend to be generalized[1] Mahdi and Taha[5] reported that 5.6% of their patients had focal seizures. Focal seizures were found to be associated with subsequent development of psychomotor epilepsy, especially if prolonged[19]. Robinson[6] suggested that a complex seizure reflects a focal, passibly structural, change and that the existence of such abnormality enhances the provocative effect of fever. The only patient in this series who continued to have epilepsy had had a focal seizure.

It has been suggested that a cluster of convulsions within 24 hours increases the likelihood of developing epilepsy[5,7,16]. However, Nelson and Ellingberg[12] found that this and other factors- like age at onset, race, sex and family history of febrile convulsions did not contribute a significant additional predictive power to the factors of family history of non-febrile seizures, prior neurologic status and first seizure type. Mahdi and Taha[5] found

seizures of the multiple type in 13% of their patients. They found comprable figures in other series. In this study 47.2% had multiple seizures. This high figure cannot be explained; though it depended, in part, upon the history given by parents. It could also reflect late reporting to hospital and failure to lower the child's temperature, thus allowing seizures to repeat itself.

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