Outcome of childhood status epilepticus and lengthy febrile convulsions: findings of national cohort study

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Abstract

Objective—To study outcome after lengthy febrile convulsions and status epilepticus in children.

Design—Population based birth cohort study.

Setting—The child health and education study (16 004 neonatal survivors born in one week in April 1970).

Subjects—Information available for 14 676 children.

Outcome measures—Clinical information and tests of intellectual performance at five and 10 years after birth.

Results—19 children had lengthy febrile convulsions and 18 had status epilepticus. Two children with status epilepticus died (one at 5 years old); neither death was directly due to the status epilepticus. Four of the 19 (21%) developed afebrile seizures after lengthy febrile convulsions compared with 14 of the 17 (82%) survivors after status epilepticus. Measures of intellectual performance were available for 33 of the 35 survivors: 23 were normal and 10 were not normal but eight of them had preceding developmental delay or neurological abnormality.

Conclusion—The outcome in children after lengthy febrile convulsions and status epilepticus is better than reported from studies of selected groups and seems determined more by the underlying cause than by the seizures themselves.

Introduction

According to a recent review, "convulsive status epilepticus is a medical emergency; prompt and appropriate treatment is essential to prevent brain damage and possible death."¹ Aicardi and Chevrie wrote that "the prognosis of children's status epilepticus is grave, mental or neurological residua or both being present in at least 57% of our patients."² In contrast papers by Maytal *et al*³ and Maytal and Shinnar⁴ reported low morbidity and mortality in status epilepticus and prolonged febrile convulsions in children, prompting the article "Status epilepticus: it's not what we've taught or thought."⁵

Why are there such differences? Hauser wrote that results from hospital based series and tertiary clinics provided biased information and that there were no population based studies of status epilepticus.⁶

The child health and education study is a population based study that has already provided information about febrile convulsions and epilepsy in children.⁷⁻¹⁰ We now report on the outcome in children in the study who had status epilepticus or lengthy febrile convulsions.

Subjects and methods

The child health and education study started as the 1970 British births survey,¹¹ which enrolled 16 004 neonatal survivors, 98.5% of the infants born in the

Measures of intellectual performance used to assess outcome at 5 and 10 years in children who had convulsions and status epilepticus

Assessment at 5 years

English picture vocabulary test
Copying design score

Assessment at 10 years

British ability scales:

Word definition
Recall of digits
Similarities
Matrices
Total score

Standardised mathematics test
Standardised reading test

United Kingdom in one week in April 1970. A total of 13 135 (82%) were assessed at 5 years of age and 14 902 (93%) at 10 years. At the assessments parents were asked: "Has the child ever had any form of convulsion, fit, seizure, or other turn in which consciousness was lost or any part of the body made an abnormal movement?" After the 10 year follow up replies were available for 14 676 children, 1318 of whom had a "suspicious event." These events were validated at five and 10 years by a questionnaire to general practitioners (92% returned) and by obtaining hospital records for 89% of those admitted. Hospital records of those who died after the neonatal period were also studied.

By 10 years of age 84 children had suffered one or more afebrile seizures and 398 one or more febrile convulsions.⁷⁻¹⁰ Suspected seizures in the neonatal period were not included. Classification of afebrile seizures was based on the proposals of the International League Against Epilepsy.¹²

Having identified the children who had suffered with one or more episodes of status epilepticus or with febrile convulsions lasting more than 30 minutes we used the clinical information from the questionnaires and hospital notes together with assessments performed at 5 and 10 years of age (box) to study outcome. Children who were in special schools because of disabilities did not undergo the formal tests.

DEFINITIONS

Epilepsy—Recurrent (more than one) afebrile seizures.

Status epilepticus—An afebrile seizure lasting more than 30 minutes or recurrent seizures lasting in total more than 30 minutes without return to consciousness.

Febrile convulsion or seizure—An event in infancy or childhood associated with fever but without evidence of intracranial infection or defined cause. Children with a history of afebrile seizures were excluded.

Lengthy febrile convulsions—Those lasting longer

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BMJ 1993;307:225-8

than 30 minutes. Children diagnosed as having encephalitis were not included. "Prolonged" febrile convulsions were those lasting more than 15 minutes.⁷⁻⁹

Remission of seizures—Two or more years free of seizures before the 10 year follow up, whether or not anticonvulsants were still prescribed.

Symptomatic seizures—Those for which there was an underlying diagnosis or history of neurological insult that could be considered a predisposing cause.

Results

INCIDENCE

Nineteen (4.8%) of the 398 children with febrile convulsions had lengthy febrile convulsions. Eighteen (21%) of the 84 children with afebrile seizures had one or more episodes of status epilepticus.

CLINICAL DETAILS

Full information is given in table I. The children with febrile convulsions tended to have the attacks at a younger age than those with status epilepticus (median age 11 months *v* 2 years 6 months). In a higher proportion of the children with febrile convulsions the episode of status was the first episode of seizures (17 (89%) *v* 12 (67%).

By definition there was no immediate underlying cause in any of the febrile group. One child, however, had a predisposing cause—cerebral palsy (spastic diplegia). Another child in the febrile group had a cold for 23 days and then started to convulse. His parents put him in a hot bath in the mistaken belief that this was the correct management. The right sided convulsion lasted four hours and on admission to hospital he had a temperature (presumed axillary) of 41.7°C. Right sided weakness persisted for several weeks and subsequently he was left handed (handedness not recorded before the attack). This was the only child in whom permanent new neurological signs were documented after a lengthy febrile convulsion.

In the status epilepticus group eight of 18 (44%) were symptomatic. The diagnoses are given in table I. In three children the underlying cause was diagnosed by the physician managing the case as encephalitis, the clinical picture being that of a prolonged febrile illness complicated by seizures and disturbance of consciousness. There was no virological or histological confirmation of encephalitis. After the episodes of encephalitis the three children were left with physical disability (hemiplegia in one and quadriplegia in two). There were no other instances when permanent new neurological signs were documented after status epilepticus.

Most children had either tonic-clonic status or generalised status with focal features. Six had complex partial status and one had prolonged atypical absence attacks; in these children it was particularly difficult to

judge the exact duration of the attacks. We did not include children unless there was evidence that the seizure itself (excluding the ensuing coma) lasted for at least 30 minutes.

Emergency management—Seventeen of the 19 children in the febrile convulsion group were admitted to hospital as an immediate result of the attack compared with 12 of the 18 with afebrile status epilepticus. In the afebrile group seven of the nine with tonic-clonic status and both children who had generalised status with focal features were admitted. Hospital records indicated that emergency treatment was appropriate, but we were not able formally to evaluate this.

OUTCOME

Full details are given in tables II and III.

TABLE II—Clinical details of outcome after lengthy febrile convulsions and status epilepticus

	Lengthy febrile convulsions	Afebrile status epilepticus
Total number in cohort	19	18
Deaths	0	2*
Subsequent prolonged episode of status	0	8/17 (47%)
Subsequent afebrile seizures	4 (21%)	14 (82%)†
Remission	16 (84%)	4 (23%)†

*One death immediately in child with haemorrhage from cerebellar haemangio-endothelioma, one death five years after episode of status (see text). †Significant difference between groups, $p < 0.005$.

TABLE III—Intellectual outcome after lengthy febrile convulsions and status epilepticus based mainly on assessments at 10 years

Detail	No of children
<i>Lengthy febrile convulsions (n = 19)</i>	
Normal	12
Not available	4 (3 Normal at 5 years)
Below normal	1 (Hot bath, 4 hour convulsion)
Special schools	2 (Preceding developmental delay*)
<i>Status epilepticus (n = 18)</i>	
Normal	7
Not available	2 (1 Normal at 5 years)
Below normal	1 (Hydrocephalus, shunt)
	1 (Head injury)
Special schools	5 (2 Previous encephalitis, 1 Rett syndrome, 1 preceding developmental delay, * 1 ? (possible birth asphyxia))
Deaths	1 (Encephalitis)
	1 (Cerebellar vascular malformation)

*Details given in table IV.

Lengthy febrile convulsions

There were no deaths and no further lengthy episodes. There was a lower rate of subsequent afebrile seizures than in the status group (4/19 (21%) *v* 14/17 (82%); χ^2 11.15; $p < 0.005$). More were in remission than were the survivors in the status group (16/19 (84%) *v* 4/17 (23%); χ^2 11.04; $p < 0.005$).

The four children with lengthy febrile convulsions developed the following afebrile seizures: single tonic-clonic seizure in one; single complex partial seizure in one; and recurrent complex partial seizures in two (both presented in the first year with lengthy febrile convulsions predominantly affecting one side).

Children who had lengthy febrile convulsions had a much greater risk of developing afebrile seizures than children in the cohort who had febrile convulsions lasting less than 30 minutes (4/19 (21%) *v* 13/379 (3.4%); χ^2 9.77; $p < 0.005$).

Intellectual outcome was based when possible on the assessments at 10 years (see table III). In the febrile group of 19 children the outcome measures were normal in 12 at 10 years, three at 5 years, and were not available in one. One was below normal on the 10 year tests—this was the boy with the four hour convulsion who had been placed in a hot bath. Two were in special schools; they were developmentally delayed before the episode of status (table IV).

TABLE I—Clinical details of children with lengthy febrile convulsions and status epilepticus

	Lengthy febrile convulsions	Afebrile status epilepticus
Total number in cohort	19 (10 girls)	18 (12 girls)
Median (range) age at time of first episode	11 Months (6 months-7 years 11 months)	2 Years 6 months (6 months-9 years)
First seizure episode ever	17 (89%)	12 (67%)
Underlying cause or predisposing condition (symptomatic)	1*	8 (44%)†
Type of status epilepticus:		
Tonic-clonic from onset	10	9
Generalised with focal features	9	2
Complex partial	—	1
Complex partial, secondarily generalised	—	5
Atypical absence	—	1
Duration of attack:		
30 Minutes-1 hour	3	3
1-2 hours	9	4
More than 2 hours	4	5
Uncertain (> 30 minutes)	3	6

*Child with spastic diplegia.

†Three children with encephalitis; single cases of haemangio-endothelioma of cerebellum, hydrocephalus requiring ventricular shunt, severe head injury with skull fracture, head injury (probably non-accidental), Rett syndrome.

TABLE IV—Children in special schools at 10 years of age. Details of those with evidence of developmental delay before first lengthy febrile convulsions or episode of status epilepticus

	Age at first lengthy attack or episode of status epilepticus	Details of developmental delay
Febrile convulsions	3 Years 1 month	Birth: irritable 9 Months: not sitting 2 Years 8 months: first walked
	2 Years 4 months	Birth: "brain damage" Diagnosis: spastic diplegia before first lengthy attack
Status epilepticus	2 Years 2 months	11 Months: not crawling 1 Year 11 months: Griffiths's developmental quotient: 59

Status epilepticus

Two children died. One was admitted in status epilepticus at 10 months of age and quickly died as a result of haemorrhage from a haemangio-endothelioma of the cerebellum. The other was admitted at 7 months of age with a prolonged febrile illness associated with seizures, which was diagnosed as encephalitis and which was followed by severe mental and physical handicap. The child died age 5 years of bronchopneumonia. We did not think that either death was due to status epilepticus.

Excluding the early death, there were further episodes of status in eight of 17 (47%). Of the 16 who survived until follow up, seven were normal on the tests of intellectual function at 10 years. Outcome measures were not available for two children at 10 years but one of them was normal when tested at 5 years (after the episode of status). The seven remaining children were either in special schools or were below normal on testing at 10 years: five of them had underlying neurological problems (see table III). One had delayed development before the episode of status epilepticus (see table IV). In the last child the seizure occurred at 15 months of age and, although delayed development was not documented, a reply on the parental questionnaire expressed concern about birth asphyxia, perhaps suggesting that early development was not normal.

In summary, there was information about intellectual outcome for 33 of the 37 children (two deaths, two not available). Twenty three were normal on testing at either 5 or 10 years. Ten were abnormal on testing at 10 years or were in special schools; in eight of these the attacks were symptomatic of an underlying neurological abnormality or the children were known to be developmentally delayed before the first attack. In one of the two remaining there may have been damage by hyperthermia after inappropriate management and in the other the possibility of birth asphyxia had been raised.

Discussion

We report better outcome than in many previous studies and we think that this is primarily because of the population based nature of the study.

Differences in outcome between studies are also partly explained by differences in the definitions used. Sometimes the term status epilepticus has been used for seizures lasting an hour or more.²¹³ We chose 30 minutes or more, in common with recent studies.³¹⁴ By our definition febrile convulsions were "without evidence of intracranial infection or defined cause." Others have defined a febrile convulsion as "any convulsion occurring in association with any febrile illness"¹⁵; this would have required that we classify two of the children with encephalitis as having had lengthy febrile convulsions. These two children were severely handicapped after the febrile illnesses, which were diagnosed as encephalitis. In Aicardi and Chevrie's 1970 study children with encephalitis were classified separately

from those with "cryptogenic" febrile status epilepticus, although the authors agreed that it was difficult to differentiate.² Fowler applied the term "febrile convulsion" to attacks lasting from one to six hours that occurred in five children, four of whom remained unconscious after the attacks until they died.¹⁶ The evidence presented in this and previous papers⁷⁻¹⁰ suggests that such catastrophic attacks are rare. Apart from the children with encephalitis and the child who became hyperthermic, probably due to mis-management of a febrile convulsion, there were no cases in this study in which permanent new neurological signs were documented after status epilepticus or lengthy febrile convulsions.

There are problems with our study—children were not objectively assessed before their febrile convulsions or afebrile seizures. Those who performed normally on standardised tests at 5 and 10 years might have done better if they had never had attacks. The children who were abnormal before the attacks might have become more abnormal as a result of them. We cannot comment on the effectiveness of the emergency treatment.

OUTCOME AFTER LENGTHY FEBRILE CONVULSIONS

Retrospective studies of patients with temporal lobe epilepsy have suggested that prolonged febrile convulsions were often the cause.¹⁷¹⁸ We found, however, that only four children of the 398 with febrile convulsions in the cohort had lengthy febrile convulsions and then developed afebrile seizures. Only two of the four developed recurrent complex partial seizures. These were the two who had lengthy focal febrile convulsions in the first year of life.⁹

A good outcome after lengthy febrile convulsions was reported from a study that was close to ours in design—the American national collaborative perinatal project, which found no statistically increased risk of subsequent epilepsy in children with first febrile convulsions lasting more than half an hour¹⁹ and no reduction in the full scale intelligence quotient (IQ) compared with sibling controls in those with febrile convulsions lasting more than an hour.²⁰

OUTCOME AFTER STATUS EPILEPTICUS

Previous papers have suggested that status epilepticus may cause brain damage and death.¹²¹³²¹⁻²⁴ There is good experimental,²⁵ radiological,²⁶ and pathological²⁷²⁸ evidence that prolonged seizures may be associated with brain damage. We agree that prompt measures should be taken to prevent seizures becoming prolonged. Like Maytal *et al*,³ however, we conclude from our study that the outcome after status epilepticus seems determined by the underlying neurological problem rather than the status epilepticus itself.

Clinical implications

- Hospital based studies of children with prolonged fits tend to select the most severe cases
- This population based birth cohort study gives a more optimistic view of outcome after prolonged febrile convulsions and status epilepticus
- Measures of intellectual performance available for 33 of the survivors at 5 or 10 years of age, or both, showed that 10 were not normal, but eight of them had had preceding developmental delay or neurological abnormality
- In this study the outcome seemed determined more by the underlying cause than by the seizures themselves

The American national collaborative perinatal study, also population based, provided similar results. In that cohort there were eight children who had at least one afebrile seizure lasting more than 30 minutes and had a sibling control. The mean IQ of the children with the seizures was just 1 point lower than that of the controls.²⁹

We thank the midwives, health visitors, general practitioners, medical records officers, and clinicians who provided essential information and also the children and their parents. Professor Neville Butler initiated the child health and education study, which was funded by the Medical Research Council, the Department of Health and Social Security, and the Gertrude H Sergievsky Center, Columbia University, New York. We are grateful to Sanofi-Winthrop for a grant to help with data analysis.

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(Accepted 13 May 1993)

Study of infection with HIV and related risk factors in young offenders' institution

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Abstract

Objectives—To estimate the prevalence of infection with HIV in young offenders in Scotland and to obtain information about related risk factors and previous tests for HIV.

Design—Voluntary anonymous study with subjects giving saliva samples for testing for HIV and completing questionnaires about risk factors.

Setting—Polmont Young Offenders' Institution near Falkirk, Scotland.

Subjects—421 of 424 available male prisoners in Polmont. The questionnaires of 17 of the prisoners were excluded because of inaccuracies.

Main outcome measures—Prevalence of infection with HIV and related risk behaviour.

Results—68 (17%) of prisoners admitted misuse of intravenous drugs, of whom 17 (25%) admitted having injected drugs while in prison. Three subjects admitted having anal intercourse while in prison. Prevalence of misuse of intravenous drugs varied geographically: 28% (33/120) of prisoners from Glasgow compared with 9% (7/81) of those from Edinburgh and Fife. A high level of heterosexual activity was reported, with 36% (142/397) of prisoners claiming to have had six or more female sexual partners in the year before they were imprisoned. Altogether 8% (32/389) of prisoners had previously taken a personal test for HIV: 50% (9/18) of those who had started misusing intravenous drugs before 1989, 18% (9/49) of those who started misuse later, and only 4% (14/322) of those who had not misused intravenous drugs. No saliva sample tested positive

for antibodies to HIV, but 96 prisoners requested a confidential personal test for HIV as a result of heightened awareness generated by the study.

Conclusions—Voluntary, anonymous HIV surveys can achieve excellent compliance in prisons, and the interest generated by the study suggests that prisons may be suitable sites for providing education and drug rehabilitation for a young male population at high risk of future infection with HIV.

Introduction

In 1991 the Scottish Prison Service started a programme of serial anonymous surveillance of the prevalence of HIV and risk factors in selected establishments. The first studies were conducted by an external research team at HM Prison Saughton, Edinburgh, in August 1991 and October 1992.^{1,2} In 1992 surveillance was extended to Polmont Young Offenders' Institution, which is Scotland's largest establishment for young male offenders (aged 16-21). Prisoners in Polmont were invited to participate in a study of HIV prevalence, risk behaviours, and uptake of HIV tests by young males in the communities served by Polmont. We report these results and compare them with previously published results about Saughton's adult prisoners.^{1,2}

Subjects and methods

Polmont Young Offenders' Institution, near Falkirk in Scotland's central region, serves the whole of

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BMJ 1993;307:228-31