Diagnosis

Lumbar puncture following febrile convulsion

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A painful pointless procedure?

Much of the medicine we practice is enshrined in dogma. The management of children following febrile seizures is no exception. Every 5–10 years, the value and need for various investigations or treatment has been revisited in the medical press. However, despite the commonness of this clinical problem, consensus over management remains elusive. In particular, the need for lumbar puncture following a febrile seizure in infancy continues to be debated despite many attempts to assess its value. This article examines current guidelines, practice, and the available evidence of the value (and potential risks) of lumbar puncture following a febrile convulsion.

CURRENT GUIDELINES

The most recently available national guidelines for the management of convulsions with fever in the United Kingdom were issued in 1991.[1] These were published in the *British Medical Journal* under the heading "For debate" and were agreed by a panel of 21 invited participants. This paper began by defining febrile convulsions as "an epileptic seizure occurring in a child aged from 6 months to 5 years, precipitated by fever arising from infection outside the nervous system in a child who is otherwise neurologically normal". The guidelines suggested that doctors should "almost certainly" perform a lumbar puncture in children under 1 year, even in the absence of signs of meningitis. However, the guidelines went on to comment that "an experienced doctor may decide on clinical grounds that a lumbar puncture is unnecessary". The American Academy of Pediatrics published its "practice parameter" in 1996.[2] It too, fell short of recommending lumbar puncture for all children under 12 months, but suggested that lumbar puncture be "strongly considered", because the clinical signs and symptoms of meningitis may be subtle.

HISTORICAL PRACTICE

There has undoubtedly been a gradual shift in practice in the United Kingdom over the past 20 years. A study in the 1970s showed that nearly all children (96%) received a lumbar puncture following their first febrile seizure.[3] By the early 1980s this number had fallen to two thirds (67%),[4] and by the early 1990s reported rates for lumbar puncture following a febrile seizure had fallen to a mere 16%.[5] The most recent large scale survey of practice was conducted in the mid 1990s in the Mersey region.[6] This study revealed a wide variation in lumbar puncture rates between hospitals but showed an overall rate of 11.5%. Unsurprisingly over half of these were in children under the age of 12 months and almost a third of children admitted with a febrile seizure in this age group underwent lumbar puncture.

CHANGES IN PRACTICE

Retrospective analysis of investigations undertaken at our centre following a febrile convulsion in infancy has been reported elsewhere.[7] This confirmed a dramatic fall in the number of lumbar punctures performed, from 62% in 1989 to nil in 1998. However, discussion with colleagues in other centres led us to believe that practice between centres varied enormously and prompted us to undertake a survey of practice across the United Kingdom.[8] Paediatric registrars from 100 randomly selected hospitals within the British Isles were contacted by telephone. They were given a clinical scenario consistent with a simple first febrile convulsion in infancy and were asked whether they would or would not perform a lumbar puncture. The results revealed that as a group the paediatric middle grade are almost split down the middle in the management of this common clinical scenario, with 46% electing to perform a lumbar puncture and 54% electing to observe the child. Interestingly the presence (or knowledge of) local guidelines had little effect on the likelihood of electing to perform a lumbar puncture.

CHANGES IN THE EPIDEMIOLOGY OF MENINGITIS

Over the past 20 years there have been significant changes in the incidence and type of bacterial meningitis seen in the paediatric population. Several authors have confirmed a dramatic reduction in the incidence of *Haemophilus influenzae* type b meningitis since the addition of the Hib conjugate vaccine to the primary course of childhood immunisations in 1992.[9–11] Recent data from the public health laboratory service confirm that the routine vaccination of children against meningococci serogroup C is already changing the patterns of meningococcal disease seen in the UK. The clinical potential of pneumococcal conjugate vaccines has been reviewed recently in this journal, and these are likely to result in further changes in the epidemiology of bacterial disease in the near future.[12] The data on which the American Academy of Pediatrics guidelines are based are now over 30 years old.[13] More recent studies have cast doubt on the assertion that purulent meningitis may be found in the absence of clinical signs in infancy.[14] The failure of subsequent researchers to confirm earlier reports of occult meningitis may well be because of a change in the patterns of disease seen in our paediatric populations.

A SYSTEMATIC REVIEW OF THE EVIDENCE

No large prospective trials exist from which it is possible to draw clear conclusions about the incidence of purulent meningitis following a febrile convulsion in infancy. A thorough literature review identified 15 "first world" papers that contained relevant data.[3–5 15–26] Only a handful of these separated data clearly for different age groups, and so it is necessary in the first instance to consider febrile convulsions in all age groups (see tables 1 and 2).

Two things are immediately obvious from these data. The first is the low incidence of bacterial meningitis as a cause for febrile convulsions. The overall incidence of bacterial meningitis is 0.8% (95% CI 0.73 to 0.88%). The second is a change in reported incidence over time. In the 1990s the incidence of bacterial meningitis as a cause of febrile convulsions has fallen to 0.23% (95% CI 0.0 to 0.46%).

Further examination of the data is possible. The majority of authors go on to comment about the presence or absence of meningeal signs. Bacterial meningitis in the absence of associated signs (irritability, lethargy, and/or bulging fontanelle) is extremely uncommon. In papers where this information was recorded, only four out of a total of 30 had no associated meningeal signs at the time of presentation. In a further three cases the presence or absence of signs of meningitis were not documented.[19]

All of these seven "non-meningitic" children underwent lumbar puncture at the time of admission and three had initially normal CSF. After 36–48 hours these three children underwent further

Table 1 First world data showing the incidence of bacterial meningitis and possible occult bacterial meningitis following a febrile convulsion

Authors	Date of publication	Journal	Number of children with febrile fit	Number with bacterial meningitis	Number with signs of meningitis
Teach and Geil	February 1999	*Pediatr Emerg Care*	243	0	0
Van Stuijvenberg *et al*	October 1998	*J Pediatr*	203	0	0
Kinsella *et al*	May 1995	*Int J Pediatr Otolaryngol*	47	0	0
Dawson and Capaldi	June 1994	*J Qual Clin Pract*	100	0	0
Lee and Verrier Jones	**November 1991**	***Arch Dis Child***	**403**	**1**	**0 (not recorded)**
McIntyre *et al*	**February 1990**	***Med J Aust***	**307**	**2 (1)***	**0 (not recorded)**
Anderson *et al*	March 1989	*Pediatr Emerg Care*	100	0	0
Rossi *et al*	May 1986	*Helv Paediatr Acta*	858	3	3
Joffe *et al*	**December 1983**	***Am J Dis Child***	**241**	**11**	**10**
Jaffe *et al*	May 1981	*Pediatrics*	562	6	6
Gerber and Berliner	May 1981	*Am J Dis Child*	100	0	0
Surpure	May 1980	*Clin Pediatr*	39	0	0
Lorber and Sunderland	April 1980	*Lancet*	452	3	3
Heijbel *et al*	February 1980	*Neuropadiatrie*	119	4	4
Rutter and Smales	**March 1977**	***Arch Dis Child***	**328**	**3 (2)**	**0**
Total			4102	33 (3)	26

Studies identifying children with bacterial meningitis that was either unsuspected clinically or in which clinical features of meningitis were not recorded are shown in **bold**.
*The number in brackets indicates the number of children who had normal CSF at the time of admission.

deterioration and developed obvious signs of meningeal irritation. Subsequent lumbar puncture showed one case of pneumococcal and two cases of meningococcal meningitis. In all cases the normal CSF resulted in a delay in antibiotic treatment and one child died. Although age is not documented in two of the seven cases, four of these children were older than a year and only one child was definitely in the 6 month to 1 year age range.

In a recent multicentre study in the UK, one sixth of children seen at hospital following a febrile convulsion were between 6 months and 1 year of age (16.7% (95% CI 16.2 to 17.2%)).[6] Extrapolation of these data shows an estimate of 685 children in the studies were infants and a calculation of a *maximum* incidence of occult meningitis in infancy following a febrile convulsion of 0.44% (95% CI 0% to 0.88%). Even this figure is probably an overestimate, assuming that where it is not documented, children are infants with no signs of meningitis but in any case illustrates the very low probability of lumbar puncture changing treatment decisions. In an infant with no signs of meningitis following a febrile convulsion, over 200 lumbar punctures would have to be performed to detect one case of unsuspected meningitis.

DISCUSSION

The hospital management of febrile convulsions has changed dramatically over the past 20 years. However, there is still a wide variation in practice between departments and individual paediatricians in the management of this common childhood condition. One in six children who attend hospital with a febrile convulsion will be under 1 year of age. A significant proportion will undergo lumbar puncture because of a perceived risk of occult bacterial meningitis in this age group. Is this justified? The available data would suggest that it is not. The risk of bacterial meningitis in the absence of other clinical signs is extremely small (less than one in two hundred), even in this age group. Furthermore, early lumbar puncture is not a sensitive predictor of meningitis in this group of patients, missing over 40% of cases if performed routinely on admission to hospital.

The belief that bacterial meningitis in infancy commonly presents with fever and seizures alone stems from one small study conducted over 30 years ago.[13] The causative organism in all these children was *H influenzae*. Historically, *H influenzae* type b was the commonest cause of bacterial meningitis in infancy. However, since the introduction of the conjugate Hib vaccine this organism is now an extremely uncommon cause of disease in the UK. Invasive *H influenzae* infection has been subject to BPSU monitoring since 1996. Although infection rates for the year 2000 have shown a small increase, levels remain well below those seen in the prevaccine era. A total of 66 cases of invasive *H influenzae* type b disease were reported in the year 2000, giving an incidence rate of 1.8 per 10 000.[27]

The routine lumbar puncture following a febrile convulsion in infancy is unjustified and potentially hazardous. As well as the pain and distress caused to the child it has been suggested that there may even be a risk of introduction of organisms from the bloodstream into the CSF during lumbar puncture.[28]

There are several possible explanations for the reduction in the rate of lumbar puncture following a febrile convulsion. Dramatic changes in the staffing of paediatric departments have occurred since the existing guidelines were proposed in 1991. In particular, there has been an expansion in registrar and middle grade doctors, providing more "on-site" expertise in the majority of centres. Almost certainly the more experienced staff are at the initial assessment of the child, the less likely they are to do a lumbar puncture. Furthermore, concerns

Table 2 Information available on those children with possible occult bacterial meningitis

Authors	No. with possible occult meningitis	Signs of meningitis documented?	Initial lumbar puncture positive	Children older than 1 year
McIntyre *et al*	2	No	1 out of 2	1
Lee and Verrier Jones	1	No	1	Age not recorded
Joffe *et al*	1	Yes	1	Age not recorded
Rutter and Smales	3	Yes	1 out of 3	3
Total	7	4/7	4/7	4/7

over the possibility of cerebral herniation (coning) following lumbar puncture have been repeatedly highlighted in the medical literature.[29 30] These have raised awareness of the potential risks of lumbar puncture in childhood. The presence of an open fontanelle is widely held to protect against coning, but a recent review shows there are definite exceptions to this rule.[31]

Our practice following a febrile convulsion in infancy follows a "less is more" philosophy, that others have applied recently to petechial rashes in infancy.[32] Infants are assessed by a middle grade paediatrician shortly after admission and those without meningeal signs (irritability, lethargy, or bulging fontanelle) who have recovered from their seizure are admitted and reviewed at four hours. If no deterioration has occurred and the child appears well, lumbar puncture is considered unnecessary.

CONCLUSION

It is clear from the available data that lumbar puncture following a febrile convulsion is unnecessary and unjustified in an infant without signs of meningitis. In an apparently well child who subsequently deteriorates, a previously normal lumbar puncture does not rule out bacterial meningitis. Observation and regular review by the nursing and medical staff in the first few hours after the convulsion, with an emphasis on examination for signs of meningitis, is more likely to detect children with bacterial meningitis and obviates the need for a painful and invasive procedure.

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