

Latex agglutination testing in bacterial meningitis

F O Finlay, H Witherow, P T Rudd

Abstract

The value of the latex agglutination test in meningitis was assessed. This was positive in 60% cases of *Streptococcus pneumoniae*, 93% of *Haemophilus influenzae* type b, and 39% of *Neisseria meningitidis* infections. We cannot support the view that this test was more valuable than Gram staining in partially treated meningitis and cannot recommend its routine use. It may, however, be valuable if Gram staining does not identify an organism or if it suggests meningococcal infection.

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Bacterial meningitis in childhood carries a significant mortality and morbidity, so accurate and rapid diagnosis is important. In the absence of contraindications, a lumbar puncture may be performed if meningitis is suspected, and the cerebrospinal fluid (CSF) sent for immediate cell count, Gram staining, and culture. Countercurrent immunoelectrophoresis and latex agglutination tests are often cited as being useful tests for rapid diagnosis, particularly when antibiotic treatment has already been started and it has been suggested that such diagnostic techniques may be more sensitive than Gram staining or standard bacterial culture.¹

Various studies reported in the literature evaluating the sensitivity and specificity of the latex agglutination test have a wide range of results. An evaluation on CSF samples by Moreno Carvalo *et al* showed that latex agglutination confirmed the aetiology in 98.2% cases of *Haemophilus influenzae* type b, 96.8% cases of *Streptococcus pneumoniae*, and only 15.8% cases of *Neisseria meningitidis* A or C.² Williams and Hart, in a study on 272 blood culture sets and 85 CSF samples, stated that the latex agglutination test 'proved valuable support to the routine bacteriological examination of blood culture and CSF'.³ Maxson *et al*, however, suggest that CSF antigen testing should be performed only when another test does not identify an organism or in an attempt to determine central nervous system infection late in treatment, thereby reducing costs without detrimental effect on patients.⁴

Because of controversy over the value of the latex agglutination test we performed a retrospective study reviewing the results of latex agglutination in all cases of bacterial meningitis in children admitted to the paediatric ward of the Royal United Hospital, Bath, over a five year period (1988-93).

Patients and methods

Children admitted to the paediatric ward aged 1 month to 16 years with bacterial meningitis in 1988-93, were included in this study. A diagnosis of bacterial meningitis was made when either bacteria were cultured from CSF using standard methods, or there were clinical signs of meningococcal septicaemia (with purpura), and CSF leucocytosis in the absence of a positive culture. In each case information was obtained with regard to age of the child, results of latex agglutination, Gram staining, and culture, and whether antibiotic treatment had started before obtaining the CSF sample.

The latex agglutination test kit (Wellcogen) is used for the qualitative detection of specific polysaccharide surface antigens from streptococcus group B; *H influenzae* type b; *S pneumoniae*; *Escherichia coli* K1; *N meningitidis* groups A, C, Y, W135 and group B. It may be used to detect antigen in various body fluids but in this study only CSF results were considered.

Results

Seventy two children were admitted with bacterial meningitis over the five year study period, but latex agglutination test results were performed in only 48 of these cases. Of these 48 children, 39 had a positive CSF culture result and another nine were included in the study as they were considered to have meningococcal meningitis, with CSF leucocytosis, and clinical features of meningitis plus a purpuric rash, in the absence of a positive CSF culture result.

In the 48 children considered in this study, the aetiology was confirmed in 28 cases (58%) by latex agglutination and in 30 cases (63%) by Gram staining (see table). The latex agglutination test confirmed the aetiology in three out of five cases (60%) of *S pneumoniae*, 14 of 15 cases (93%) of *H influenzae* type b, seven of 18 cases (39%) culture positive for *N meningitidis*, and four of nine cases (44%) where there was a clinical diagnosis of meningococcal meningitis but where culture results were negative. The latex agglutination test did not detect group B streptococcus in our one patient. A Gram stain was positive in four out of five (80%) cases of *S pneumoniae*, 10 of 15 cases (67%) of *H influenzae*, 12 of 18 cases (67%) of cases culture positive for *N meningitidis*, and three of nine cases (33%) where there was a clinical diagnosis of meningococcal meningitis but where the culture results were negative.

Twenty six children received antibiotics before lumbar puncture. The latex agglutination test was positive in 13 cases (50%) and the Gram stain also positive in 13 cases (50%). Eight of the nine (89%) children with a clinical

Royal United Hospital,
Bath

F O Finlay
H Witherow
P T Rudd

Correspondence to:
Dr F O Finlay, Child Health
Department, Newbridge
Hill, Bath BA1 3QE.

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Investigation results

Patient No	Age (years)	Organism isolated from CSF	Latex agglutination test result	Gram stain test result	Antibiotics before lumbar puncture
1	0.5	<i>S pneumoniae</i>	+	+	No
2	1.3	<i>S pneumoniae</i>	-	+	Yes
3	1.7	<i>S pneumoniae</i>	+	+	No
4	2	<i>S pneumoniae</i>	+	+	No
5	4	<i>S pneumoniae</i>	-	-	Yes
6	0.5	<i>H influenzae</i>	+	+	No
7	0.6	<i>H influenzae</i>	+	-	Yes
8	0.7	<i>H influenzae</i>	+	+	No
9	0.8	<i>H influenzae</i>	+	+	No
10	0.8	<i>H influenzae</i>	+	+	No
11	1.1	<i>H influenzae</i>	+	-	Yes
12	1.1	<i>H influenzae</i>	+	+	No
13	1.2	<i>H influenzae</i>	+	+	No
14	1.2	<i>H influenzae</i>	+	-	Yes
15	1.3	<i>H influenzae</i>	+	+	Yes
16	1.4	<i>H influenzae</i>	+	+	Yes
17	1.4	<i>H influenzae</i>	+	+	No
18	1.7	<i>H influenzae</i>	+	+	Yes
19	3	<i>H influenzae</i>	-	-	Yes
20	16	<i>H influenzae</i>	+	-	No
21	0.1	Group B streptococcus	-	+	No
22	0.5	<i>N meningitidis</i>	+	+	Yes
23	0.5	<i>N meningitidis</i>	-	+	No
24	0.5	<i>N meningitidis</i>	+	+	Yes
25	0.5	<i>N meningitidis</i>	-	+	No
26	0.6	<i>N meningitidis</i>	+	+	No
27	0.9	<i>N meningitidis</i>	+	-	No
28	1.2	<i>N meningitidis</i>	-	+	No
29	1.5	<i>N meningitidis</i>	-	-	No
30	3	<i>N meningitidis</i>	-	-	No
31	3	<i>N meningitidis</i>	-	+	Yes
32	4	<i>N meningitidis</i>	-	-	Yes
33	5	<i>N meningitidis</i>	+	+	No
34	5	<i>N meningitidis</i>	-	-	Yes
35	5	<i>N meningitidis</i>	-	-	Yes
36	13	<i>N meningitidis</i>	+	-	No
37	15	<i>N meningitidis</i>	-	-	Yes
38	15	<i>N meningitidis</i>	+	+	Yes
39	16	<i>N meningitidis</i>	-	+	Yes
40	0.2	Meningococcal infection*	+	+	Yes
41	2	Meningococcal infection*	-	-	Yes
42	3	Meningococcal infection*	-	-	No
43	3	Meningococcal infection*	-	-	Yes
44	4	Meningococcal infection*	-	-	Yes
45	4	Meningococcal infection*	-	-	Yes
46	15	Meningococcal infection*	+	+	Yes
47	16	Meningococcal infection*	+	-	Yes
48	17	Meningococcal infection*	+	+	Yes

*Those with a clinical diagnosis of meningococcal meningitis had CSF leucocytosis, and clinical features of meningitis plus a purpuric rash, in the absence of a positive CSF culture result.

diagnosis of meningococcal meningitis, but negative culture results, had received antibiotics before lumbar puncture.

Discussion

In practice broad spectrum antibiotics are given to a child with a CSF leucocytosis irrespective of the Gram stain or latex agglutination test result, until culture results and sensitivities are available.

Thus in this study the six children with CSF leucocytosis who had a negative Gram stain, but positive latex agglutination test result, would have received antibiotic treatment whether or not this test was performed. The eight children who had a positive Gram stain but a negative latex agglutination test also received antibiotic treatment. Thus the results

of the latex agglutination test did not influence whether or not antibiotics were prescribed.

In children who had been given antibiotics before lumbar puncture the latex agglutination test and Gram stain were each positive in 50% of cases, although there was not complete agreement between the Gram stain and latex agglutination test results. These results do not therefore support the claim that the latex agglutination test is of greater value than Gram staining in arriving at a diagnosis once antibiotic treatment has started. There may be public health benefits in the early identification of the infecting organism in cases of meningitis. Even if there is a positive Gram stain for meningococci, use of the two meningococcal latex agglutination tests may allow identification of different serotypes and immunisation may be given in the case of meningococcal types A and C.

These results showed latex agglutination testing to be most sensitive in the detection of *H influenzae* meningitis, and although this form of meningitis is now rarely seen early identification of *H influenzae* may allow prompt introduction of chemoprophylaxis. Although there is still controversy over the use of steroids in the management of childhood meningitis, there is some evidence that dexamethasone administration before antibiotic treatment is beneficial in cases of haemophilus meningitis,^{5,6} so early detection of infection may be important.

From our results we feel that latex agglutination testing is not justified if the Gram stain is positive unless meningococci are identified, when clarification of the serotype may be beneficial. If the Gram stain does not identify an organism a latex agglutination test may be performed, although antibiotics would generally be given irrespective of the result if meningitis is suspected clinically.

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- 1 Tilton RC, Dias F, Ryan RW. Comparative evaluation of three commercial products and counterimmunoelectrophoresis for the detection of antigens in cerebrospinal fluid. *J Clin Microbiol* 1984; 20: 231-4.
- 2 Moreno Carvalho OA, Livramento VA, Machado LR, Spina-Franca A. Latex agglutination tests of the cerebrospinal fluid: an analysis of 333 cases. *Arq Neuropsiquiatr* 1988; 46: 365-8.
- 3 Williams RG, Hart CA. Rapid identification of bacterial antigen in blood cultures and cerebrospinal fluid. *J Clin Pathol* 1988; 41: 691-3.
- 4 Maxson S, Lewno MJ, Schutze GE. Clinical usefulness of cerebrospinal fluid bacterial antigen studies. *J Pediatr* 1994; 125: 235-8.
- 5 McCracken GH, Lebel MH. Dexamethasone therapy for bacterial meningitis in infants and children. *Am J Dis Child* 1989; 143: 287-9.
- 6 Lebel MH, Freij BJ, Syrogiannopoulos GA, et al. Dexamethasone therapy for bacterial meningitis: results of two double-blind, placebo-controlled trials. *N Engl J Med* 1988; 319: 964-71.