Does this adult patient have acute meningitis?
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Authors' objectives
To review the accuracy and precision of the clinical examination in the diagnosis of adult meningitis.

Searching
MEDLINE was searched from 1966 to July 1997 using a structured search strategy that was not provided in the paper, but which is available from the authors on request. Additional references were identified by searching the reference lists of pertinent articles. The search was restricted to articles in English or French.

Study selection
Study designs of evaluations included in the review
No inclusion criteria specific to study design were reported.

Specific interventions included in the review
Articles describing the clinical examination in the diagnosis of meningitis were included. The individual components of the clinical history were headache, nausea and vomiting, and neck pain. The individual components of the physical examination were fever, neck stiffness, altered mental status, focal neurologic findings, rash, Kernig sign and jolt accentuation of headache.

Reference standard test against which the new test was compared
The reference standard used to diagnose meningitis was lumbar puncture or autopsy.

Participants included in the review
Studies in which the majority of patients had objectively confirmed bacterial or viral meningitis were included. Studies were excluded from the review if they enrolled only children or immunocompromised adults; described mixed patient populations from which adult data could not be extracted; or focused only on metastatic meningitis, or meningitis of a single specific microbial origin (i.e. Listeria meningitidis or Mycobacterium tuberculosis). Tuberculous meningitis was also excluded on the grounds that this infection is more prevalent in patients with human immunodeficiency virus infection and children; however, in two studies in which there were insufficient data to separate the patients with tuberculous meningitis, the authors have retained them in their analysis. The patients were aged between 16 and 95 years.

Outcomes assessed in the review
Sensitivities for the various signs and symptoms of meningitis were calculated from the data in each study. For the prospective study, the specificities and likelihood ratios were also presented.

How were decisions on the relevance of primary studies made?
The articles were reviewed for relevance by one of the authors. It was not stated whether the author was blinded to the results and/or source.

Assessment of study quality
The authors state that there is no widely established quality grading system for chart reviews. Therefore, they critically appraised several components of the study design, including an assessment of the reference standard used to diagnose meningitis, the completeness of patient ascertainment, and whether the clinical examination was described in sufficient detail to be reproducible. The authors do not state how the appraisal was conducted.

Data extraction
The authors do not state how the data were extracted for the review, or how many of the reviewers performed the data extraction.

Data were extracted on the precision and accuracy of the clinical examination in the diagnosis of meningitis. Data were also collected on the following study characteristics: clinical setting, years, number of patients, age, type of meningitis, patient identification, and whether the clinical findings were defined. The sensitivities for the various signs and symptoms of meningitis were calculated from the data in each study. The specificity and likelihood ratios were calculated if sufficient data were available.

**Methods of synthesis**

How were the studies combined?
The pooled sensitivities were calculated for each feature of the clinical examination using a random-effects model.

How were differences between studies investigated?
The authors do not state a method for assessing differences between the studies.

**Results of the review**

Ten studies were included in the review: one prospective study (54 patients) and 9 retrospective chart reviews (824 patients presenting 845 patient-episodes).

Accuracy of the clinical history in the diagnosis of meningitis.

The individual components of the clinical history had low sensitivity for the diagnosis of meningitis. The pooled sensitivity was 50% (95% confidence interval, CI: 32, 68) for headache (7 studies) and 30% (95% CI: 22, 38) for nausea and vomiting (3 studies). Neck pain was only assessed in one study and the sensitivity was 28% (CI not reported).

One prospective trial found a specificity of 15% for a nonpulsatile headache, 50% for a generalised headache and 60% for nausea and vomiting.

Accuracy of the physical examination in the diagnosis of meningitis.

The pooled sensitivities for the individual elements of the physical examination were as follows: 85% (95% CI: 78, 91) for fever (10 studies), 70% (95% CI: 58, 82) for neck stiffness (10 studies), 67% (95% CI: 52, 82) for altered mental status (10 studies), 46% (95% CI: 22, 69) for triad of fever, neck stiffness and altered mental status (3 studies), 23% (95% CI: 15, 31) for focal neurologic findings (9 studies), 22% (95% CI: 1, 43) for rash (4 studies), 9% for Kernig sign (1 study), and 97% for jolt accentuation of headache (1 study).

The sensitivity for the presence of two or more symptoms of fever, neck stiffness and altered mental status was 95%, while the sensitivity for the presence of at least one of these clinical findings was between 99 and 100% (2 studies).

The prospective study reported that fever had a low specificity of 45%. Kernig sign had a sensitivity of 9% and a specificity of 100%, while neck stiffness had a sensitivity of 15% and a specificity of 100%.

Jolt accentuation of headache yielded a sensitivity of 97% and a specificity of 60%. The associated positive likelihood ratio was 2.4 and the negative likelihood ratio was 0.05.

**Authors' conclusions**

Among adults with a clinical presentation that is low risk for meningitis, the clinical examination aids in excluding the diagnosis. However, given the seriousness of this infection, clinicians frequently need to proceed directly to lumbar puncture in high-risk patients. Many of the signs and symptoms of meningitis have been inadequately studied, and further prospective research is needed.
CRD commentary
The review question and the inclusion criteria were stated clearly. The literature search was limited to one electronic database and may have missed relevant studies. No attempt was made to identify unpublished studies and publication bias was not assessed. The quality of the studies was systematically assessed, although the results were not discussed or used to weight the individual studies.

The methods used to pool the studies were appropriate but heterogeneity was not assessed. It is, therefore, unclear whether it was appropriate to pool the studies. The results were tabulated clearly and discussed narratively.

The authors’ tentative conclusions appear justified owing to the limitations highlighted and the paucity of prospective research in this area.

Implications of the review for practice and research
Practice: The authors make suggestions on how to optimise the use of the clinical examination, based on the limited studies included in this systematic review.

1. The absence of all three signs of the classic triad of fever, neck stiffness and an altered mental status virtually eliminates a diagnosis of meningitis.

2. The most sensitive of the classic triad of signs of meningitis is fever, which occurs in a majority of patients, followed by neck stiffness. Alterations in mental status also have a relatively high sensitivity, indicating that normal mental status helps to exclude meningitis in low-risk patients. Changes in mental status are more common in bacterial than viral meningitis.

3. Among the signs of meningeal irritation, Kernig and Brudzinski signs appear to have low sensitivity but high specificity.

4. Jolt accentuation of headache may be a useful adjunctive manoeuvre for patients with fever and headache. In patients at sufficient risk of meningitis, a positive test result may aid in the decision to proceed to lumbar puncture, whereas a negative test result essentially excludes meningitis.

Research: The authors state that the signs and symptoms of meningitis have been inadequately studied and that more prospective research is required. A well-designed prospective study, in which patients suspected of having meningitis are observed prospectively, is necessary to definitely establish the accuracy of meningeal signs.

Bibliographic details

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10411200

Original Paper URL
http://jama.ama-assn.org/

Other publications of related interest
This additional published commentary may also be of interest. Parrino TA. Review: the physical examination can exclude the diagnosis of meningitis in low-risk adults. Evid Based Med 2000;5:28.

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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.