Retrospective Analysis: Are Fever and Altered Mental Status Indications for Lumbar Puncture in a Hospitalized Patient Who Has Not Undergone Neurosurgery?

Mark L. Metersky, Andrew Williams, and Albert L. Rafanan

Although nosocomial meningitis is rare in nonsurgical patients, lumbar punctures are frequently performed on hospitalized medical patients who develop delirium and/or fever. A retrospective review was undertaken to determine the yield of lumbar puncture in this setting and to compare it with the yield for suspected community-acquired meningitis. Of 232 lumbar punctures studied, 51 (22%) were performed to rule out nosocomial meningitis, while 181 (78%) were done to rule out community-acquired meningitis. No lumbar puncture performed for suspected nosocomial meningitis was positive, while results of 26 (14%) of those done for suspected community-acquired meningitis were abnormal (P < .01). Patients whose lumbar punctures were positive more often had headache or meningeal signs than those whose lumbar punctures were negative, and only 11 patients (22%) who had lumbar punctures performed for suspected nosocomial meningitis had headache or meningeal signs. We conclude that lumbar punctures performed for suspected nosocomial meningitis in nonsurgical patients have a low yield and that in some low-risk patients without headache or meningeal signs, lumbar puncture may be unnecessary.

Because of the excessive morbidity and mortality associated with delays in treatment of bacterial meningitis, it is common practice to perform an immediate lumbar puncture upon any patient with symptoms suggestive of bacterial meningitis, no matter how unlikely the diagnosis is thought to be. Statements such as “If you think of doing a spinal tap, do one” are seen in standard medical textbooks [1]. Although delirium is extremely common among hospitalized patients, especially the elderly [2], the prevailing dogma suggests that most patients who develop delirium, especially in the presence of fever, should receive a lumbar puncture to rule out meningitis [3].

Hospitalized patients often have bacterial infections that prompt admission; others have indwelling catheters, placing them at risk for bacteremia and potential meningeal seeding. Therefore, it would seem that many hospitalized patients indeed are at risk for meningitis and should undergo a lumbar puncture if they develop delirium, as delirium is a common sequela of meningeal infection.

See editorial response by Täuber on pages 289–91.

However, nosocomial meningitis is most commonly seen in neurosurgical patients; data from the National Nosocomial Infection Surveillance System revealed a rate of only seven episodes per 100,000 discharges among adult nonsurgical patients [4]. One study at a large tertiary referral center found only six cases over a 25-year period that were not associated with procedures involving the CNS or with spreading from contiguous sites of infection [5]. While Durand et al. [6] recently reported that over a 27-year period 40% of bacterial meningitis cases seen at the Massachusetts General Hospital were nosocomial, most were seen in patients who had undergone invasive neurological procedures.

Because nosocomial meningitis is rarely seen in hospitalized nonsurgical patients, yet such patients often undergo lumbar punctures when they develop delirium and/or fever in the hospital, we reviewed the yield of lumbar puncture for nonsurgical patients in two teaching hospitals. In doing so, we hoped to determine what findings prompt the decision to perform a lumbar puncture as well as to define which patients should undergo lumbar puncture. As the yield of lumbar puncture for adults with either suspected community-acquired or suspected nosocomial meningitis has not been well defined, both populations were studied.

Methods

Patients. This was a retrospective study of patients at two hospitals who underwent lumbar puncture to exclude the diagnosis of infectious meningitis. All inpatients and outpatients who had a CSF sample sent to the microbiology laboratory between 1 March 1992 and 30 September 1993 were identified. The records only of nonsurgical patients who were older than the age of 15 years were reviewed for potential inclusion in the study.

Received 17 September 1996; revised 31 March 1997. Grant support: In part by General Clinical Research Center grant no. M01RR 06192.

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Upon review of the records, we included only patients for whom the lumbar puncture was documented to have been performed to rule out acute CNS infection. Therefore, patients who underwent lumbar puncture for suspected neurosyphilis or Lyme disease, as well as patients who underwent lumbar puncture as a means of following the course of a previously diagnosed infection, were excluded from the study. Patients who had undergone prior invasive procedures involving the CNS were also excluded.

Hospitals. The study was performed at two teaching hospitals served by separate internal residency programs and attending staffs, with a slight overlap in house-staff coverage. Mount Sinai Hospital (Hartford, CT) is a 294-bed inner-city, community teaching hospital affiliated with the University of Connecticut School of Medicine. The University of Connecticut Health Center (Farmington, CT) is a 232-bed referral center, served primarily by the faculty at the University of Connecticut School of Medicine.

Data collection and analysis. Demographic data abstracted from the records included age, gender, and reason for presentation to the hospital. Also noted was substance abuse or immunosuppression associated with HIV or bone marrow transplantation. The following indications for lumbar puncture were noted: (1) a new abnormal mental status or worsening of mental status that was abnormal at baseline (we did not attempt to specifically define the degree of abnormality because of the limitations of retrospective review); (2) fever; (3) headache; and (4) findings suggesting meningeal irritation, such as neck stiffness or pain or a positive Kernig’s or Brudzinski’s sign.

Patients were defined as having suspected community-acquired meningitis if the lumbar puncture was performed for signs or symptoms that arose outside of the hospital or during the first 48 hours of admission. If the indication(s) for the lumbar puncture arose >48 hours following admission, the patients were considered to have suspected nosocomial meningitis.

A positive lumbar puncture was defined by any of the following circumstances. (1) An infection was proved by culture or appropriate stain. (2) Aseptic (presumed viral) meningitis was diagnosed when there was a typical clinical presentation encompassing fever, headache, and meningeal signs and the CSF analysis revealed lymphocytic pleocytosis and no pathogens. (3) A noninfectious condition was revealed by one or more CSF abnormalities (abnormalities such as an elevated protein level or the presence of RBCs alone were not considered to be indicative of abnormal CSF, unless they were in the context of a diagnosed noninfectious CNS condition). In addition, one case was defined as bacterial meningitis, despite a negative culture and gram stain, because of neutrophilic pleocytosis and a typical clinical presentation and response to therapy. Complications of lumbar puncture were noted.

The results from the two hospitals were combined. Statistical analysis was performed with the SAS statistical package (SAS Institute, Cary, NC). Demographic data were analyzed with the unpaired Student’s t-test and the Fisher’s exact test. The differences in indications for lumbar puncture between the community-acquired and nosocomial groups and the yield of lumbar puncture with respect to the presenting symptoms were analyzed by means of the Fisher’s exact test. Statistical significance was accepted at $P < .05$.

Results

During the 20-month study period, 232 lumbar punctures were performed at the two hospitals because of a suspicion of meningital infection. Of these, 181 (78%) were for suspected community-acquired meningitis, while 51 (22%) were performed for suspected nosocomial meningitis. Of the patients with suspected nosocomial meningitis, only one was known to have a site of infection contiguous to the CNS.

The demographic characteristics of each group are shown in Table 1. A clinically significant complication of lumbar puncture was noted for only one patient. The occurrence of a severe headache after the lumbar puncture resulted in readmission to the hospital and a second lumbar puncture. Twenty-six (14.4%) of the lumbar punctures performed for suspected community-acquired meningitis were positive, while there were no positive lumbar punctures for suspected nosocomial meningitis ($P < .01$).

The indications for the lumbar puncture differed greatly between the nosocomial group and the community-acquired group (Table 1). Patients undergoing lumbar puncture for suspected nosocomial meningitis were much less likely to have headache or meningeal signs but were more likely to have an abnormal mental status, while there was no significant difference in the incidence of fever.

Table 1 also demonstrates the diagnostic yield of lumbar puncture with respect to the indications. The absence of headache or meningeal signs was strongly predictive of a negative lumbar puncture, with a negative predictive value of 0.98. The presence of either of these findings was quite sensitive for the finding of meningitis, with a sensitivity of 0.92. Table 2 reveals the diagnoses associated with the positive lumbar punctures.

Discussion

The diagnostic yield of a procedure is proportional to the prevalence of the disorder being investigated. We found the yield of lumbar puncture performed to rule out nosocomial meningitis to be quite low in our patient population (despite the impression of one of us [M.L.M.] that the threshold for performing a lumbar puncture is even lower at many academic medical centers than at the two hospitals in the current study). This contrasts with the much higher yield obtained from lumbar punctures performed to rule out community-acquired meningitis. To our knowledge, this issue has not been studied before; however, the results are not surprising since nosocomial menin-
Table 1. Demographic characteristics and clinical indications for lumbar puncture with respect to the two patient groups (with suspected community-acquired vs. suspected nosocomial meningitis) and CSF findings.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Abnormal CSF (n = 26)</th>
<th>Normal CSF (n = 155)</th>
<th>Total (n = 181)</th>
<th>Nosocomial group* (n = 51)</th>
<th>Normal CSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Age (y), mean ± SD</td>
<td>40 ± 14</td>
<td>54 ± 22</td>
<td>52 ± 22</td>
<td>59 ± 20</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>17 (65)</td>
<td>79 (51)</td>
<td>96 (53)</td>
<td>33 (65)</td>
<td></td>
</tr>
<tr>
<td>HIV-infected</td>
<td>8 (31)</td>
<td>25 (16)</td>
<td>33 (18)</td>
<td>10 (20)</td>
<td></td>
</tr>
<tr>
<td>Bone marrow transplant recipient</td>
<td>1 (4)</td>
<td>0 (0)</td>
<td>1 (1)</td>
<td>5 (10)§</td>
<td></td>
</tr>
<tr>
<td>Substance abuser</td>
<td>7 (27)</td>
<td>46 (30)</td>
<td>53 (29)</td>
<td>19 (37)</td>
<td></td>
</tr>
<tr>
<td>At presentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td>19 (73)</td>
<td>83 (54)</td>
<td>102 (56)</td>
<td>24 (47)</td>
<td></td>
</tr>
<tr>
<td>Mental status changes</td>
<td>13 (50)</td>
<td>101 (65)</td>
<td>114 (63)</td>
<td>40 (78)§</td>
<td></td>
</tr>
<tr>
<td>Meningeal signs or headache</td>
<td>24 (92)</td>
<td>78 (50)</td>
<td>102 (56)</td>
<td>11 (22)§</td>
<td></td>
</tr>
</tbody>
</table>

* Except for age, data are numbers (%) of patients per category with indicated characteristic.

1: $P < .05$ vs. total community-acquired group.

2: $P < .0001$ vs. normal CSF group.

§: $P < .00001$ vs. total community-acquired group.

Meningitis is rare in patients who have not undergone procedures involving the CNS. During a 25-year period reviewed at The Ohio State University Hospitals (Columbus, OH), there were only eight such patients with nosocomial meningitis, amounting to only 2% of all cases of meningitis seen during that period. While data from the National Nosocomial Infections Surveillance System revealed that nosocomial CNS infections occurred during seven of every 100,000 hospitalizations on the medical service [4], an unknown number were associated with procedures involving the CNS.

Lumbar puncture is considered a benign procedure, with serious complications being very rare. Indeed, only one significant complication was noted in relation to the 232 lumbar punctures in the current study (a severe headache prompting performance of a second LP). The most common complication is post–lumbar puncture headache, which occurs in as many as 25% of patients and is usually minor and self-limited [7]. However, serious complications of lumbar puncture do occur.

Table 2. Final diagnoses for 26 patients with suspected community-acquired meningitis and abnormal CSF.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. (%) of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aseptic meningitis</td>
<td>13 (50)</td>
</tr>
<tr>
<td>Cryptococcal meningitis</td>
<td>6 (23)</td>
</tr>
<tr>
<td>Pneumococcal meningitis</td>
<td>3 (12)</td>
</tr>
<tr>
<td>Bacterial, organism unknown</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Tuberculous meningitis</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Herpes meningoencephalitis</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Subarachnoid hemorrhage</td>
<td>1 (4)</td>
</tr>
</tbody>
</table>

Although it is not known how often diagnostic lumbar puncture results in iatrogenic meningitis, such cases have been reported [7]. The risks of spinal hematoma with neurologic sequelae, prolonged paresthesias, and cranial nerve palsies are well known [7]. Other serious complications of lumbar puncture, such as permanent hearing loss [8] and intracranial subdural hematoma [9], are well documented but less well known. Overall, the risk of significant complication following lumbar puncture has been estimated to be 0.3% [10].

As the yield of lumbar puncture to rule out nosocomial meningitis was so low when performed at the level of clinical suspicion used by the physicians during the current study, even with little risk, the risk-benefit ratio may not be favorable. Therefore, any data that could identify patients with a higher likelihood of having nosocomial meningitis might improve the risk-benefit ratio associated with this issue. As we detected no cases of nosocomial infection, we can provide no direct data on what signs and symptoms predict the presence of nosocomial meningitis. Presumably, the clinical manifestations differ little from those of community-acquired meningitis [4], although we found no study reports that offered data on this issue.

We found that 92% of patients with meningeal infection had either meningeal signs or headache. This is in agreement with Durand et al. [6], who found that 88% of adult patients with community-acquired bacterial meningitis had nuchal rigidity, with an unknown additional number of patients having headache without nuchal rigidity. They found that this percentage was not significantly different among elderly patients, in contrast to data from an earlier study [11].

While other large series have found a lower incidence of meningeal signs and headache in patients with bacterial meningitis, they included a high percentage of cases from the pediat-
ric population [12], in whom the signs and symptoms of meningitis are often less specific. In the current study, only 11 of 51 patients (22%) with suspected nosocomial meningitis had either headache or meningeal signs. Therefore, most of these 51 patients had the procedure performed to investigate the possibility of a disorder that was rare in this setting and of which there was little clinical evidence.

In agreement with prior studies, we have demonstrated that nosocomial meningitis is rare in nonsurgical patients [2, 5, 6]. Although risk factors for nosocomial meningitis in such patients have been well defined [4], we found that many lumbar punctures performed to rule out nosocomial meningitis were undergone by patients who did not have any of these well-recognized risk factors. Furthermore, most of the patients did not have headache or nuchal rigidity, making the diagnosis of meningitis even less likely.

The common recommendation that lumbar puncture be performed on all patients with fever and mental status changes [3] is not supported by this study. Instead, inpatients with such symptoms should be carefully evaluated, with careful consideration of underlying risks for meningitis as well as possible alternative explanations for fever or mental status changes. Such consideration may allow lumbar puncture to be avoided for many of these patients, averting both the economic cost and the potential for complications.

On the basis of both our results and the published experience with community-acquired meningitis [6], we believe that the presence of headache or nuchal rigidity concurrent with fever or mental status changes should prompt urgent performance of a lumbar puncture, unless an alternative etiology is identified.

Acknowledgments

The authors thank Jonathan Clive, Ph.D., for assistance with the statistical analysis, as well as Barry Zingman, M.D., and David Dorsky, M.D., for their helpful critique of the manuscript.

References