

## Editorial Response: To Tap or Not to Tap?

Discussions about whether to subject a patient to a lumbar puncture (LP) are undoubtedly held numerous times every day in hospitals around the world. These discussions point to the uncertainties with regard to the precise indications and contraindications of the procedure. An LP is not as casually performed as a venous blood collection or a urine analysis because the procedure is not without risk. Thus, as with any medical procedure that entails more than negligible risk, the decision to perform an LP must take into account four factors: the risk to the patient inherent in the procedure, the danger associated with missing a diagnosis that would be uncovered by the procedure, the likelihood that the procedure will result in a diagnosis relevant for the patient's care, and the cost of the procedure. Given the interdependency of these four factors, it may be useful to review them briefly to put into perspective the article by Metersky and colleagues in this issue [1].

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See article by Metersky et al. on pages 285–8.

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### Complications of LPs

A series of complications of lumbar punctures are well recognized, even though it is difficult to determine their exact frequency. By far the most common complication is post-LP headache, which is observed in 10%–35% of patients [2–4]. The headache typically develops gradually after an LP, is described as frontal-retroorbital throbbing pain, the intensity of which depends on the patient's position, and can last for several days to 2 weeks. In the study of Metersky et al. [1], one of 232 patients had severe post-LP headache leading to readmission, and no other serious adverse effects were reported. The low incidence of post-LP headaches is likely a reflection of the retrospective nature of the study, where such adverse effects were not prospectively monitored.

The most devastating complication of LP is uncal and cerebellar tonsillar herniation. Cerebral herniation is likely (i.e., >1% of patients are at risk) to occur in patients with an intracranial mass lesion that has led to incomplete herniation with partial obstruction of CSF flow at the foramen magnum [2–4]. After removal of CSF in the lumbar space, the pressure gradient between the cranial and spinal CSF compartment cannot readily equilibrate, leading to progressive herniation with the potential for catastrophic damage. Given this pathogenesis

of cerebral herniation, it is critical to avoid LPs in patients with neurological findings pointing to a focal lesion associated with increased intracranial pressure (i.e., focal neurological findings, including visual defects, and mental status changes, headache, vomiting, and papillary edema).

Bacterial meningitis, in the absence of a circumscribed mass lesion such as an abscess, can also lead to cerebral herniation, probably as a result of severe diffuse brain edema [5]. Within the first few hours after an LP, cerebral herniations seem to occur more frequently than before or later after an LP, suggesting that in a subset of patients the LP may precipitate cerebral herniation [6, 7]. However, proof of a causal link is complicated by the fact that performance of an LP and institution of antibiotic therapy often occur within a short period of time.

The latter leads to the release of proinflammatory bacterial products, with a subsequent increase of inflammation and brain edema [8, 9], and it is difficult to assess whether initiation of antibiotics, the LP, or their combination contributes to cerebral herniation in patients with bacterial meningitis. Since CSF examination is critical for the optimal management of bacterial meningitis, LP should be performed in cases of suspected meningitis in the absence of clinical findings pointing to a focal lesion associated with intracranial hypertension, despite the small risk that the LP may precipitate cerebral herniation.

Rare complications of LP include severe back pain, paresthesias and leg numbness, cortical blindness, and spinal cord infarction. In patients with bleeding disorders or who have been treated with anticoagulant drugs, serious bleeding complications can occur at the site of the puncture or intracranially. The risk that bacteria may be introduced into the CSF space if an LP is performed while a patient is bacteremic is small and should not deter performance of an otherwise indicated LP [2–4].

### Danger of Not Diagnosing Meningitis

Untreated bacterial meningitis is associated with a mortality rate that approaches 100% when caused by aggressive pathogens such as pneumococci [10]. Prompt and adequate therapy is therefore mandatory. Given the severity of the disease, it has become routine to initiate antibiotic therapy for patients suspected of having rapidly progressive bacterial meningitis, even before an LP is performed. In addition, hospitalized patients with a new fever are commonly treated with broad-spectrum antibiotics (i.e., third-generation cephalosporins) that cover meningeal pathogens.

Thus, many hospitalized patients with meningitis receive appropriate antibiotics either as empiric therapy for an undefined febrile illness or as treatment for suspected meningitis, and failure to diagnose meningitis in the hospital setting does not automatically result in failure to treat. In keeping with this,

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limited data suggest a lack of significant adverse effect on outcome for patients with suspected meningitis in whom LP was not promptly performed [11].

### Likelihood of a Relevant Finding on LP

The decision to perform an LP must also be guided by the likelihood that the test will yield a positive finding. This, in turn, is primarily determined by the patient's clinical presentation, including epidemiological aspects and physical examination findings. The article by Metersky and colleagues addresses the yield of lumbar punctures performed on hospitalized patients who developed fever and mental status changes and for whom the treating physicians perceived a need to rule out nosocomial meningitis.

In their retrospective study, the authors found that none of 51 LPs performed to rule out nosocomial meningitis in patients who had not previously undergone neurosurgical procedures revealed abnormal CSF findings, while 14% of LPs for suspected community-acquired meningitis revealed abnormal findings. It is worth noting that 78% of the patients who underwent LP to rule out nosocomial meningitis had neither headache nor nuchal rigidity. Given that >90% of adult patients with documented bacterial meningitis have headaches and an almost equally high percentage have evidence of meningismus [12], the majority of patients described in the study by Metersky et al. [1] thus had a low pretest probability for bacterial meningitis.

The merit of the study is that it raises the issue of whether, in such a patient population, LP is a reasonable test to perform. The limitations of the study are its retrospective nature, the relatively small number of patients (the 95% upper confidence limit for an abnormal LP, ~6%), and the lack of data about treatment with antibiotics that would have covered bacterial meningitis. Patients who previously had undergone neurosurgical procedures were excluded, and it is important to keep in mind that these patients are at substantial risk for CNS infections, which can be difficult to diagnose clinically.

### Cost of LP

The current cost for an LP charged to the patient at San Francisco General Hospital is about \$300. This includes the physician fee, the LP tray, and a set of routine laboratory tests (cell count and differential, protein and glucose concentrations, gram stain, and routine bacterial and fungal cultures). Cost does not justify the withholding of an LP when it is indicated for the purpose of case management.

Whether the cost of an LP is sufficiently high that it may be cost-effective to identify clinical situations in which LPs have a very low diagnostic yield, yet are performed relatively frequently, is open for discussion. For example, had no LP been performed on the 51 patients in the study by Metersky et al. [1], this would have reduced charges by ~\$15,000 over a 19-month period.

### Conclusions and Recommendations

LP is not without risk, and the decision to perform an LP must be made after consideration of the pros and cons for individual patients, as described above. It may be helpful to consider as a continuum the clinical situations in which the question of an LP for the diagnosis of meningitis arises. On one end of the spectrum are patients with a high pretest probability of meningitis. This group includes patients with fever, headache, signs of meningismus, and altered mental status. The nature of the mental status changes should also be taken into account to assess the likelihood of a patient's having meningitis.

Meningitis typically leads to mental status changes characterized by progressive lethargy, confusion, stupor, and coma. Delirium, which is a confusional state associated with agitation and autonomic dysfunction, is not typical for meningitis (contrary to the statements by Metersky et al. [1]). Patients with signs and symptoms compatible with meningitis should promptly undergo LP, unless there is suspicion of a mass lesion with intracranial hypertension. In such cases, the LP should be delayed until an imaging study has been performed. Antibiotic therapy should be initiated before the patient undergoes radiological examination, and close monitoring is necessary while the patient is undergoing diagnostic procedures.

On the opposite end of the spectrum are the patients with very low pretest probability of bacterial meningitis, i.e., patients with no headache, meningismus, or fever or whose mental status changes are uncharacteristic of meningitis, such as delirium. These patients may not need to undergo LP routinely, as suggested by Metersky and colleagues [1]. This is particularly true if the patient is already being treated with antibiotics that cover meningeal pathogens. As stated, this applies only to patients who have no complicating risk factors, such as previous neurosurgical procedures or head trauma. HIV infection should also be included here, since cryptococcal meningitis, the most common form of meningitis in AIDS patients, often presents without meningismus and headache [13].

It is important to conclude by pointing out that all attempts to formulate recommendations with regard to the indications for LP are tenuous at best. In the end, the treating physician must make a decision to tap or not to tap on the basis of careful assessment of the individual patient, by taking into account the factors outlined above. Studies like the one by Metersky et al. [1] should, more than anything else, remind us of the need to carefully consider the risks and benefits of an LP for each patient.

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