

# The Effectiveness of Lumbar Puncture in the Evaluation of Delirium and Fever in the Hospitalized Elderly

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**Objective:** To determine the value of the cerebrospinal fluid examination in the evaluation of hospitalized, elderly patients with delirium and fever.

**Design:** A retrospective case series of consecutive events during a 15-month period.

**Setting:** Tertiary care center.

**Participants:** Elderly patients admitted to the University of Cincinnati (Ohio) Hospital between July 1, 1988, and October 1, 1989, who had a lumbar puncture and cerebrospinal fluid evaluation to evaluate fever and mental status changes.

**Main Outcome Measures:** Primary intracranial causes and the clinical characteristics of delirium and fever.

**Results:** Eighty-one hospital admissions were reviewed.

Fifty-seven (70%) of the lumbar punctures were performed as part of the admitting workup, and the remaining 24 (30%) were performed during the hospitalization. Eighty of the 81 cerebrospinal fluid cultures were negative for bacterial growth. The primary origins for fever and delirium included urinary tract infections (25%), pneumonia (22%), viral causes (17%), and metabolic causes/dehydration (14%). One case of bacterial meningitis was diagnosed in an alcoholic, 73-year-old man who was unresponsive in the emergency department. One case of presumed aseptic meningitis was diagnosed in a 65-year-old man who presented with fever and headaches and a blood pressure of 230/100 mm Hg.

**Conclusions:** Most hospitalized, older patients with fever and delirium have primary causes of the confusion outside the central nervous system and may not require a routine evaluation of their cerebrospinal fluid.

(*Arch Fam Med.* 1993;2:293-297)

**D**ELIRIUM IS a common problem among the hospitalized elderly. At the time of admission, it is estimated that 15% to 25% of older patients may have acute confusion.<sup>1</sup> The prevalence of confusion may increase during hospitalization and this has been correlated with advanced age.<sup>2</sup> Several factors predispose elderly patients to delirium. The onset of an acute physical illness may significantly worsen the cognitive status of a patient with a mild or moderate preexisting dementia. Fever, regardless of its origin, may precipitate confusion in an older patient. Also, sensory deficits, especially those of vision and hearing, place a patient at a disadvantage in interpreting environmental data, especially in the hospital. Older patients are also vulnerable to the side effects of medications.

When recognized, delirium is a medical emergency and requires aggressive assessment to identify the underlying cause of the confusion. The causes of delirium can be divided into four major groups: (1) primary intracranial disease (eg, meningitis or intracranial bleeding), (2) systemic diseases secondarily affecting the brain, (3) exogenous toxic agents, and (4) withdrawal from alcohol or medications.<sup>3</sup> It is not known how often delirium in the elderly is caused by primary intracranial disease. In older people, delirium from systemic disease is common and may result

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## MATERIALS AND METHODS

This retrospective chart review was completed on consecutive admissions to the University of Cincinnati (Ohio) Hospital between July 1, 1988, and October 1, 1989. Inclusion criteria were (1) age 65 years and older; (2) LP and CSF evaluation, including a culture, performed during hospitalization; and (3) clear indication on the patient's chart that the reason for the LP was to evaluate the patient's fever and mental status changes. Cases were identified by reviewing laboratory records of CSF examination on all patients aged 65 and older during the study period. Patients who received LPs for other indications and patients who may have had delirium and did not have an LP were not studied.

The chart audits were completed by two trained abstractors (F.T. and a medical student) using a standardized abstract form. The abstractors compared abstract forms regularly to ensure interrater consistency. Demographic data collected included age, race, sex, and the living situation before and after hospitalization. Admission and discharge diagnoses were reviewed. Historical data analyzed included selected symptoms from the history of present illness, and mental status before hospitalization, at the time of the LP, and at the time of discharge. Physical examination findings collected included temperature, nuchal rigidity, photophobia, and focal neurological findings. Laboratory tests reviewed included urinalysis and culture, chest roentgenography, complete blood count, electrolyte levels, creatinine, serum urea nitrogen, glucose, calcium, magnesium, albumin, blood cultures, arterial blood gas values, and computed tomograms of the head. Cerebrospinal fluid analysis components collected included the red and white blood cell counts; cerebrospinal fluid, glucose, and protein studies; and microbiology.

from infections (especially urinary tract infection and pulmonary), dehydration, electrolyte disorders, or hypoxia (eg, secondary to congestive heart failure, chronic pulmonary disease, or pneumonia).

The challenge for the clinician is to recognize confusion as a symptom requiring a search for an underlying cause. After a careful history from family and caregivers, and a physical examination, some laboratory tests are frequently needed to identify the cause of the delirium. The appropriate use of the laboratory in this assessment process is still unclear. Should a broad range of tests be ordered, or should the use of the laboratory be tailored for each individual case? This is a particular challenge when older patients present to the emergency department or to the hospital with fever and delirium.

Standard medical textbooks recommend that a lumbar puncture (LP) and the laboratory evaluation of the cerebrospinal fluid (CSF) be part of the initial evaluation of delirium, especially when fever is present.<sup>4,5</sup> The CSF evaluation is usually directed at the identification of infection, hemorrhage, or meningeal carcinomatosis—all possible causes of delirium. This is the standard of care on the medical service in our hospital.

This article describes a retrospective case series of elderly patients admitted to a university teaching hospital who had LPs for the evaluation of fever and mental status changes. We were concerned with the clinical characteristics of these patients and specifically evaluated the value of the LP in the process of diagnosing the cause of the patients' delirium.

## RESULTS

Eighty-one hospital admissions were reviewed, representing 71 patients (10 patients were admitted and met the inclusion criteria twice during the study period). Sixty-five of the admissions (80%) were to a general medical ward and 16 (20%) were to the medical intensive care unit. **Table 1** lists the demographic characteristics of these patients.

**Table 2** lists the frequency of selected reported symptoms noted by the patient or an informant and recorded in the chart. Lethargy and poor oral intake were noted most often; headache was noted in only one patient.

Patients had a mean  $\pm$  SD temperature of  $38.9^{\circ}\text{C} \pm 0.75^{\circ}\text{C}$  (range,  $37.1^{\circ}\text{C}$  to  $41.9^{\circ}\text{C}$ ) before the LP. The presence or absence of nuchal rigidity was noted in 72 patients. Sixteen patients (20%) were noted to have nuchal rigidity. Cranial nerve examinations were noted in 64 patients. Seven patients (9%) had abnormal cranial

Table 1. Patient Characteristics (N=81)\*

Characteristic	No. (%) of Patients
Age, y	
65-74	35 (43)
75-84	28 (35)
>85	18 (22)
Sex	
M	42 (52)
F	39 (48)
Race	
W	28 (35)
B	53 (65)
Living situations before admission	
Home	52 (64)
Nursing home	26 (32)
Other	3 (4)

\*Eighty-one hospital admissions were reviewed representing 71 patients (10 patients were admitted and met the inclusion criteria twice during the study period). The mean ( $\pm$ SD) age of the patients was  $76 \pm 7.5$  years.

**Table 2. Selected Symptoms Before Lumbar Puncture (N=81)**

Symptom	No. (%) of Patients
Lethargy	25 (31)
Decreased appetite	18 (22)
Impairment of consciousness	8 (10)
Nausea or vomiting	6 (7)
Headache	1 (1)

nerve examinations. The presence or absence of focal neurological findings were noted in 64 charts. Five patients (6%) had focal findings (it could not be determined if these findings were present before this episode of illness).

Baseline mental status was noted to be abnormal before admission in 37 patients (46%). The remaining patients were noted to have normal orientation before admission. All patients were disoriented at the time of the LP. Twenty-four patients (30%) were noted to have normal orientation at the time of discharge.

Laboratory values obtained near the time of the LP are noted in **Tables 3 and 4**. Electrolyte disturbance and dehydration were common findings, with urea nitrogen levels elevated in 72% of patients. Fifty-four percent of the patients had elevated white blood cell counts. The chest roentgenograms and urine cultures were important sources of diagnostic information. Fifty-one patients had head computed tomography completed as part of the workup for the delirium. None of these examinations identified pathologic features that explained the patients' confusion.

Fifty-seven (70%) of the LPs were performed as part of the admitting workup, and the remaining 24 (30%) were performed at the time that confusion and fever developed during hospitalization. Eighty of the 81 CSF cultures were negative for bacterial growth. One case of bacterial meningitis was diagnosed. *Listeria monocytogenes* grew from the blood and CSF of a 73-year-old man. He pre-

sented to the emergency department with a temperature of 39.4°C and was unresponsive. He had a history of alcohol use. His blood leukocyte count was  $11.2 \times 10^9/L$  and his arterial pH was 7.23.

One case of aseptic meningitis was diagnosed in a 65-year-old man who presented with fever (temperature, 39.2°C) and headaches (the only patient in this series in which this symptom was documented). This man presented with a blood pressure of 230/100 mm Hg without nuchal rigidity, without photophobia, and no focal neurological findings. On admission, his blood leukocyte count was  $15.0 \times 10^9/L$ , with negative urine and blood cultures. His chest roentgenogram and head computed tomogram showed no abnormalities. The CSF examination disclosed the following values: glucose, 3.5 mmol/L (63 mg/dL); serum glucose, 6.1 mmol/L (110 mg/dL); protein, 9.0 g/L; and  $141 \times 10^6/L$  total blood cells:  $89 \times 10^6/L$  red blood cells and  $52 \times 10^6/L$  white blood cells. There were 94% segmented neutrophils and the CSF cultures were negative for bacterial growth.

The most likely primary diagnostic cause of the remaining cases of delirium and fever are listed in **Table 5**. Urinary tract infection (25%) and pneumonia (22%) were the most common causes of delirium and fever in this series.

## COMMENT

This chart review confirms the diverse presentation and cause of delirium in the hospitalized elderly. The clinical assessment of these patients is challenging. Sixteen of our patients were believed to have nuchal rigidity, but this finding did not occur in the two confirmed cases of meningitis. In our experience, the presence of cervical arthritis in older patients makes this physical finding unreliable. Five patients had focal neurological findings, not unusual in older patients, which were difficult to interpret without an accurate, recorded, baseline physical examination.

**Table 3. Laboratory Values Obtained Before Lumbar Puncture (N=81)**

	Mean±SD	Range	Low Values*	High Values*
Sodium, mmol/L	138±8.37	117-161	[<135] 24 (30)	[>147] 9 (11)
Carbon dioxide, mmol/L	25.8±9.7	9-52	[<22] 21 (26)	[>28] 20 (25)
Urea nitrogen, mmol/L of urea (mg/L)	13.3±9.6 (37±26.9)	2.5-35.3 (7.0-98.9)	[<3.0 (8.0)] 1 (1)	[>6.5 (18.0)] 58 (72)
Glucose, mmol/L (mg/dL)	11.05±9.71 (199±175)	3.61-52.73 (65-950)	[<3.9 (70)] 3 (4)	[>6.1 (110)] 57 (70)
Calcium, mmol/L (mg/dL) (collected on 52/81)	2.1±1.0 (8.4±4.0)	1.3-3.0 (5.2-12.0)	[<2.20 (8.8)] 35 (43)	[>2.58 (10.3)] 1 (1)
Magnesium, mmol/L (mg/dL) (collected on 27/81)	0.33±0.36 (0.8±0.88)	0.06-1.1 (0.15-2.7)	[<0.80 (1.8)] 22 (27)	[>1.20 (3.0)] 0
Hemoglobin, g/L	122±23	53-183	[<115] 28 (35)	[>180] 1 (1)
Leukocytes, $\times 10^9/L$	14.9±13.8	4.2-62.1	[<3.2] 1 (1)	[>9.8] 44 (54)

\*Data for low values and high values appear in brackets, followed by the number (percentage) of patients.

**Table 4. Results of Additional Diagnostic Tests Obtained by Lumbar Puncture (N=81)**

Test	No. (%) of Patients
Chest roentgenogram	
No acute changes	48 (62)
Pneumonia	25 (32)
Congestive heart failure	5 (6)
Urine culture	
Negative culture	36 (51)
>100 000 organisms per milliliter	20 (28)
10 000-100 000 organisms per milliliter	5 (7)
1-10 000 organisms per milliliter	6 (8)
Yeast	4 (6)
Head computed tomography	
Negative examination	46 (90)
Old cerebrovascular accident	5 (10)
Blood culture	
Negative culture	63 (91)
<i>Escherichia coli</i>	3 (4)
Gram-positive	2 (3)
<i>Listeria</i>	1 (1)

Thirty-seven patients were noted to have baseline confusion before presenting to the hospital. Older adults with dementia are at high risk of developing delirium, and the recognition of delirium can be difficult. The acutely confused patient is usually also noisy and restless, but this presentation could also represent an agitated patient with dementia. An abrupt change in behavior, with fluctuation in mental status, is common in delirium. Mental status assessments must be repeated frequently. Simple interventions may cause dramatic change (eg, control of fever or administration of fluid may considerably improve a delirium). In our study, only 24 patients had normal mental status at the time of hospital discharge. A portion of the remaining 57 patients included those patients with underlying dementias; however, many older patients with delirium will not clear their confusion during hospitalization. Koponen et al<sup>6</sup> reported a series of delirium admissions in which the mean duration of the delirious episode was 20 days (range, 3 to 81 days). Recovery is usually gradual, with episodes of nocturnal delirium persisting after apparent recovery during the daytime.

The 81 cases of delirium and fever reviewed in this retrospective chart audit are comparable to those in other series in the literature. In a 1990 article, Francis et al<sup>7</sup> reported a prospective study of 50 cases of older patients with delirium admitted to the general medical units in a university hospital. Abnormal serum sodium levels, pre-existing dementia, and fever were all associated with delirium. In this series, only two of the 50 subjects had a primary intracerebral source for the delirium. This is consistent with our findings that most causes of delirium in the older, hospitalized patient have a source that originates outside the central nervous system (CNS). This ap-

pears to be true even in patients who present with fever and confusion.

When meningitis occurs in the older patient, the origin is usually bacterial or mycobacterial. Viral meningitis can occur, but it is less common in the elderly. In the elderly, the bacterial cause of meningitis includes *Streptococcus pneumoniae*, aerobic gram-negative bacilli, *Listeria monocytogenes*, *Neisseria meningitidis*, and *Haemophilus influenzae*.<sup>8</sup> Most patients will present with typical symptoms of fever, headaches, and altered mental status. In one series comparing older and younger patients with meningitis, delirium was significantly more common as a presenting symptom among the older patients.<sup>9</sup>

The patient with *Listeria* meningitis in our series was very ill on initial evaluation, and was unconscious. In addition to this patient, seven other patients presented with severely impaired consciousness. In all of these cases, dehydration and/or electrolyte disturbances was the likely cause of the disturbed sensorium.

A number of limitations are inherent in a retrospective case series. We were not able to study all cases of delirium, or the cases of delirium and fever in which an LP was not performed. However, we examined all cases of delirium and fever that precipitated a decision to examine the CSF. This group of patients should have the highest likelihood of meningitis. Reliance on the medical record to identify cases of delirium and the associated clinical data is a limitation of a retrospective chart audit. It is possible that some target cases were not identified because of limited medical record information. Finally, this study was performed in an urban, tertiary care hospital and our results may not apply to other clinical settings. In our hospital, patients with fever and delirium have considerable comorbidity, likely increasing the risk of CNS infection. In suburban and rural hospitals, fever and delirium may be even less likely to be associated with meningitis.

Our data support the conclusion that in most cases of delirium and fever in the elderly, a source for the delirium

**Table 5. Primary Diagnostic Causes for Fever and Delirium (N=81)**

Cause	No. (%) of Patients
Urinary tract infections	20 (25)
Pneumonia	18 (22)
Viral/cause not found	14 (17)
Multiple causes	12 (15)
Metabolic/dehydration	11 (14)
Malignancy	2 (2)
<i>Listeria</i> meningitis	1 (1.25)
Viral meningitis	1 (1.25)
Fecal impaction	1 (1.25)
Anemia	1 (1.25)

will be found outside the CNS. Examination of CSF is difficult to justify for all cases of delirium and fever in the older patient. Several basic questions remain unanswered:

1. Can clinical data be used to identify characteristics of elderly patients with fever and delirium who either definitely should have a CSF examination on presentation, or who may forgo this procedure? Our data cannot answer this question; however, we support the use of diagnostic LP in all older patients with delirium without an identified source for the change in mental status.

2. Does the risk of secondary bacterial meningitis warrant the use of diagnostic LP in all older patients with infections outside the CNS and delirium? Gorse et al<sup>9</sup> found that in 71 older patients with bacterial meningitis, pneumonia was present in 22 (31%) and urinary tract infections were present in nine (13%). In another series of 48 patients aged 60 years and older with a diagnosis of bacterial meningitis, concurrent infections were present in one half of the patients (eg, pneumonia, tuberculosis, otitis media, or sinusitis).<sup>10</sup> However, our data suggest that in patients with delirium and infections outside the CNS, the occurrence of concomitant CNS infection is rare. More research is needed to clarify this issue.

3. Why not perform a diagnostic LP on all older, delirious patients? As discussed, delirium is a common problem among older people presenting to the hospital. A significant majority of these patients will not benefit from an evaluation of their CSF. It is possible that delays in the appropriate treatment of the actual cause of the delirium will occur during the time that an LP and/or an associated brain-imaging study are being performed. In addition, agitated, confused, older patients are not easy subjects for the LP procedure. The use of sedation to perform diagnostic procedures in acutely confused older patients can significantly distort the clinical picture. Traumatic LPs are not uncommon in this situation (44 of 79 negative LPs performed in our series had more than  $10 \times 10^6/L$  red blood cells) and may lead diagnostic and treatment plans astray.

In summary, this retrospective study of 81 episodes of fever and delirium demonstrated one case of bacterial meningitis and one case of probable viral meningitis. Both of these cases had distinctive clinical features. Our data suggest that most older patients with delirium and fever have primary sources outside the CNS as the cause of confusion and may not require a routine evaluation of their CSF. More research is needed to better define the characteristics of this group at low risk of CNS disease.

Accepted for publication December 16, 1992.

This research was supported by academic award K07-AG00466-02 from the National Institute on Aging, Bethesda, Md (Dr Warsaw).

Reprints not available.

## REFERENCES

1. Levkoff SE, Besdine RW, Wetle T. Acute confusional states (delirium) in the hospitalized patient. In: Eisdorfer C, ed. *Annual Review of Gerontology and Geriatrics*. New York, NY: Springer Publishing Co Inc; 1986;6:1-26.
2. Warsaw GA, Moore JT, Friedman SW, et al. Functional disability in the hospitalized elderly. *JAMA*. 1982;248:847-850.
3. Lipowski ZJ. Delirium in the elderly patient. *N Engl J Med*. 1989;320:578-582.
4. Plum F, Posner JB. Disturbances of consciousness and arousal. In: Wynn-gaarden JB, Smith LH, eds. *Cecil Textbook of Medicine*. Philadelphia, Pa: WB Saunders Co; 1988:2065.
5. Folstein M, Rovner B, Tune L, Warren A, Brandt J. The cognitively impaired patient. In: Harvey AM, Johns RJ, McKusick VA, Owens AN, Ross RS, eds. *The Principles and Practice of Medicine*. East Norwalk, Conn: Appleton & Lange; 1988:1138.
6. Koponen H, Stenback U, Mattila E. Delirium in elderly persons admitted to a psychiatric hospital: clinical course during the acute stage and one-year follow-up. *Acta Psychiatr Scand*. 1989;79:579-585.
7. Francis J, Martin D, Kapoor WN. A prospective study of delirium in hospitalized elderly. *JAMA*. 1990;263:1097-1101.
8. Yoshikawa T, Norman DC. *Aging and Clinical Practice: Infectious Diseases*. New York, NY: Igaku-Shoin Medical Publishers Inc; 1986:91.
9. Gorse GJ, Thrupp LD, Nudleman KL, Wyle FA, Hawkins B, Cesario TC. Bacterial meningitis in the elderly. *Arch Intern Med*. 1984;144:1603-1607.
10. Rasmussen HH, Sorensen HT, Moller-Petersen J, Mortensen FV, Nielsen B. Bacterial meningitis in elderly patients: clinical picture and course. *Age Ageing*. 1992;21:216-220.