

# Cerebrospinal Fluid Lactate as a Prognostic Indicator in Postneurosurgical Bacterial Meningitis and Use of Intrathecal Colistin

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## Abstract

Postneurosurgical bacterial meningitis (PNBM) is an emergency and requires early diagnosis and treatment with appropriate antibiotics. The cornerstone of diagnosis is microbiological analysis of the cerebrospinal fluid (CSF) cytochemical characteristics such as leucocyte count, CSF glucose, and protein concentration and CSF: Serum glucose ratio. However, this is often misleading in PNBM. The role of CSF lactate assay for diagnosis and prognosis has been debated. This case report looks into the serial measurement of CSF lactates in PNBM. It also looks into the role of intrathecal colistin. CSF lactate showed a steady decrease corresponding to improvement in clinical condition. Hence, CSF lactate could have a better prognostic value than other conventional markers in PNBM. Intrathecal colistin, in conjunction with the standard antibiotics, can contribute to a quick resolution of the condition.

**Keywords:** Cerebrospinal fluid lactate, intrathecal colistin, postneurosurgery meningitis diagnosis

## INTRODUCTION

Bacterial meningitis is not rare in postneurosurgical patients and has an incidence of approximately 0.3%–1.5%.<sup>[1]</sup> However, clinical manifestations such as fever, signs of meningeal irritation, and an altered mental status lack specificity and sensitivity.<sup>[2]</sup> Hence, the observed incidence in clinical practice may be higher than this number. Furthermore, the intraoperative aseptic inflammatory response induced by blood, bone chips, sloughing tissue, and surgical implants, as well as the widespread postoperative administration of prophylactic antibiotics, increase the difficulty of diagnosing postoperative bacterial meningitis (PNBM) through routine cerebrospinal fluid (CSF) analysis and CSF culture.<sup>[2]</sup> The delayed administration of antibiotics and corticosteroids or the unnecessary administration of these agents can result in impaired treatment effects.<sup>[2,3]</sup> If patients with bacterial meningitis are not treated promptly, the mortality rate can reach 20%–50%.<sup>[3]</sup> Therefore, early and accurate diagnosis is critical for PNBM.

Studies show that CSF lactate is efficient in distinguishing between bacterial meningitis and aseptic meningitis<sup>[4,5]</sup>

and is superior to routine CSF analysis. It is also useful in differentiating between PNBM and aseptic meningitis;<sup>[6]</sup> however, no systematic evaluations have investigated this aspect. In addition, a rapid decrease in the CSF lactate level following antibiotic treatment could suggest a relatively good prognosis.<sup>[7,8]</sup>

The CSF lactate test is simple, objective, and affordable.<sup>[3]</sup> It can be performed at the bedside and the results received within 15 min. The examination is not affected by either blood contamination of the CSF<sup>[9,10]</sup> or serum neutrophil count.<sup>[3,11]</sup> Therefore, CSF lactate may play a significant role in the diagnosis of PNBM.

## CASE REPORT

A 17-year-old female patient, with no comorbidities, was brought to the Emergency Room with a history of fever

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and headache since 1 day and one episode of generalized tonic-clonic seizures. On arrival, she was disoriented and had another episode of GTCS. Her pupils noted to be unequal with 4 mm dilatation on the right. Computed tomography scan of the brain showed a hemorrhage in the right gangliocapsular and thalamic region with intraventricular extension and midline shift of 10 mm and severe cerebral edema. She was taken up for emergency craniotomy and evacuation of hematoma and placement of external ventricular drain (EVD). Postoperatively, she was drowsy and remained intubated and on mechanical ventilation.

She developed fever, with a peak temperature of 38.8°C, 3 days after admission, with worsening mentation, tachycardia, tachypnea, and hypotension, requiring Noradrenaline infusion. Blood, urine, and endotracheal secretions cultures sent at admission were negative. CSF analysis at the onset of fever revealed a lactate of 8.9 mmol, glucose of 22 mg/dl, protein of 120 mg/dl and a WBC count of 300/mm<sup>3</sup>, with 85% polymorphonuclear leukocytes and 15% lymphocytes. CSF Gram-stain showed Gram-negative bacilli. The EVD was removed on the same day, as a possible source of the infection. A new EVD was placed on opposite side for intracranial pressure monitoring.

She was empirically started on intravenous meropenem and teicoplanin, pending the CSF culture result. In addition, she was given colistin 10 mg (125,000 IU) once daily, for the initial 3 days through the new ventricular drain, followed by direct injection into subarachnoid space by spinal needle for 7 days. This was done considering the poor CSF penetration of intravenous colistin.

CSF culture yielded multidrug-resistant *Acinetobacter baumannii* sensitive only to colistin. Daily measurements of CSF lactate level [Table 1] showed a gradual reduction in lactate levels from 8.9 mmol on day 1, 7.9 mmol on day 2, 5.5 mmol on day 4, 3.5 mmol on day 6, and 1.2 mmol on day 8. This was associated with an improvement in clinical parameters and GCS score. A repeat CSF culture showed no growth. She was shifted to ward after 2 weeks in ICU and discharged uneventfully 2 weeks later.

## DISCUSSION

PNBM is an urgent problem which requires early diagnosis and treatment. While CSF culture remains the “gold standard” for the diagnosis of bacterial meningitis, the yield is usually low for a variety of reasons, including the low volume and contamination of the CSF sample, time constraints and antibiotic drug administration. In addition, CSF culture requires several days to generate a result. Thus, it is possible to miss the diagnosis of meningitis when using only CSF analysis as a diagnostic tool. Etiological study in addition to CSF cytology and biochemical examinations may be used to achieve better efficacy.

**Table 1: Daily cerebrospinal fluid analysis findings through the course of intrathecal colistin**

Parameter (unit)	Day from initiation of intra-thecal colistin				
	Day 1	Day 2	Day 4	Day 6	Day 8
Leukocyte count (cells/mm <sup>3</sup> )	385	284	100	60	3
Lactic acid (mmol/dl)	8.9	7.9	5.5	3.5	1.2
Dextrose (mg/dl)	67	69	20	40	70
Protein (g/liter)	400	360	120	100	50
Chloride in CSF (meq/ml)	130	125	118	115	109

CSF: Cerebrospinal fluid

All-cause mortality from *Acinetobacter meningitis* ranges from 15% to 71%, with the higher mortality rates seen in patients with carbapenem-resistant *Acinetobacter*.<sup>[12]</sup>

Some cases of multidrug-resistant Gram-negative meningitis may not show improvement when treated with conventional intravenous antimicrobial agents alone. Such cases should be treated additionally with intrathecal polymyxin B or colistin; however, due to their toxicity, these agents are not currently used.<sup>[13,14]</sup> In this case, the patient had a successful outcome and was discharged without any complications.

In other reports, Colistin has been administered intraventricularly by EVD and by externalization of a VP shunt,<sup>[15,16]</sup> and intrathecally by an external lumbar drainage or by lumbar puncture.<sup>[17]</sup> Guidelines published by the Infectious Diseases Society of America in 2004, suggest that the intraventricular dosage of colistin should be 10 mg every 24 h.<sup>[18]</sup> Falagas *et al.* have summarized the evidence about the intrathecal and intraventricular use of polymyxins in a systematic review of the literature.<sup>[19]</sup> New techniques such as polymerase chain reaction can improve diagnostic sensitivity. New diagnostic markers, such as procalcitonin, sCD163, and C-reactive protein, have also been reported.<sup>[19]</sup> Some researchers have tested the efficacy of combinations of markers and obtained optimistic results.<sup>[20]</sup> However, most studies concerning these markers are retrospective or have small sample sizes.

The present case report suggests a good efficacy of CSF lactate in both diagnosis and prognosis of PNBM through serial lactate measurements, in keeping with the findings of a meta-analysis by Xiao *et al.*<sup>[21]</sup> This test is fast, simple, objective, and affordable and can be widely used. Furthermore, in cases of meningitis caused by multidrug-resistant Gram-negative bacilli, intrathecal administration of colistin could be considered as an effective treatment.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published

and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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### Conflicts of interest

There are no conflicts of interest.

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