International Surgery Journal
Narate SS et al. Int Surg J. 2026 Feb;13(2):303-306
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902
DOI: https://dx.doi.org/10.18203/2349-2902.isj20260146

Case Report

Proteus mirabilis meningitis following lumbar spine surgery in an elderly diabetic patient: a rare case report

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Received: 28 November 2025
Accepted: 05 January 2026

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ABSTRACT

Postoperative meningitis is a rare complication following spine surgeries, more commonly caused by gram-positive organisms. *Proteus mirabilis*, a gram-negative bacillus, is a highly unusual causative agent, particularly in adults and post-spinal surgery cases. Elderly patients with comorbidities, especially diabetes mellitus, are at elevated risk for serious postoperative infections, with prognosis dependent on early diagnosis and aggressive management. A 76-year-old female with diabetes mellitus underwent transforaminal lumbar interbody spinal fusion (TLIF) for L4-L5 spondylolisthesis. She presented with altered sensorium, vomiting and generalised seizures ten days post-discharge. CSF analysis confirmed neutrophilic pleocytosis and culture yielded *Proteus mirabilis* which is extremely rare occurrence. Management with intravenous antibiotics and supportive care led to complete neurological recovery. Extensive literature review confirms the rarity of such cases and highlights the formidable mortality associated with gram-negative postoperative CNS infections. This case underscores the necessity of high vigilance for atypical pathogens in elderly, immunocompromised patients presenting with CNS symptoms post-surgery and the critical importance of timely, targeted therapy for optimal outcomes.

Keywords: *Proteus mirabilis*, Postop meningitis, Spine surgery, Diabetes mellitus, TLIF, Immunocompromised, Case report

INTRODUCTION

Postoperative central nervous system (CNS) infections following lumbar spine surgeries are rare, with reported incidence rates ranging from 0.1% to 0.7%.[1] Postoperative spinal infections have been linked to additional patient morbidity, such as fixation failure, pseudarthrosis, osteomyelitis, discitis and even mortality. Gram-negative organisms are infrequently implicated in postoperative meningitis, with *Proteus mirabilis* being an exceptionally rare pathogen in this context.[2]

The causative pathogens of meningitis differ among different patient populations. Community-acquired infections are commonly caused by *S. pneumoniae*, *H. influenzae*, *L. monocytogenes*, *N. meningitidis*, and group B *Streptococci*. Since the initiation of childhood vaccination programs, incidence and mortality associated with meningitis has been noticed in decreasing trend in high-income countries. Worldwide, *S. pneumoniae* and *N. meningitidis* are the most common pathogens in adults.[3]

Proteus belongs to the family *Enterobacteriaceae*. *Proteus mirabilis* and *Proteus vulgaris* are the most clinically significant, gram-negative, facultatively anaerobic rods. Highly motile, shows swarming on agar plates (Figure 1 and 2) *Proteus mirabilis* is frequently implicated in urinary tract infections, wound infections,

and postoperative complications. Hematogenous seeding from primary foci, like urinary tract infections (UTIs), are the most common primary source or direct inoculation during neurosurgical procedures.[4]

Early diagnosis and aggressive management are critical, particularly in high-risk populations such as the elderly and those with comorbidities like diabetes mellitus. We present an extremely rare and unique case of meningitis that occurred post-operatively by *Proteus mirabilis* following an elective TLIF for the L4-L5 spondylolisthesis.

CASE REPORT

A 76-year-old female, known to have type 2 diabetes mellitus and hypertension, presented with chronic low back pain radiating to both lower limbs. Radiological assessment confirmed L4-L5 spondylolisthesis. Preoperative blood investigations were unremarkable. Following pre-anesthesia clearance, she underwent TLIF under general anesthesia. The procedure was uneventful, and the patient was discharged in stable condition after an initially smooth recovery.

Ten days post-discharge, she was readmitted with altered sensorium, multiple vomiting episodes, and generalized seizures. On examination, she was afebrile, random sugar 300 mg/dl, GCS 10/15, 130beats/min pulse rate, 30 cycles/min respiratory rate, 160/90 mm of Hg blood pressure and 96% saturation on room air, neck stiffness present. Differential diagnoses considered included meningitis, diabetic ketoacidosis, metabolic encephalopathy, and seizure disorder.

Table 1: Investigations on the day of admission.

Tests	Findings	Interpretation
CSF analysis	Cloudy, marked neutrophilic pleocytosis, degenerated cells, no atypical cells, elevated protein (2360 mg/dl), decreased glucose (05 mg/dl)	Seen in bacterial meningitis
CSF culture	*Proteus mirabilis* grown	Confirms the causative organism for meningitis
CSF India ink	Negative	No cryptococcal infection
Urine culture	No growth seen	No urinary tract infection
Urine ketones	Positive	Suggests ketosis
Blood culture	Proteus species grown	Confirms *Proteus* bacteremia
NT-proBNP, D-dimer, procalcitonin (PCT), C-reactive protein (CRP)	Elevated PCT=21 ng/ml CRP=272 mg/L	Indicates systemic inflammation and possible sepsis
serum ammonia	Elevated (143 ug/dl)	Metabolic dysfunction
serum uric acid	Elevated (6.4 mg/dl)	Renal involvement, metabolic stress
Complete blood count	Leukocytosis (14870/ul)	Suggests infection, inflammatory response
NCCT head	Showed diffuse age-related cerebral atrophy, chronic bilateral gangliocapsular infarcts, and non-specific ischemic changes.	Suggests underlying neurological vulnerability

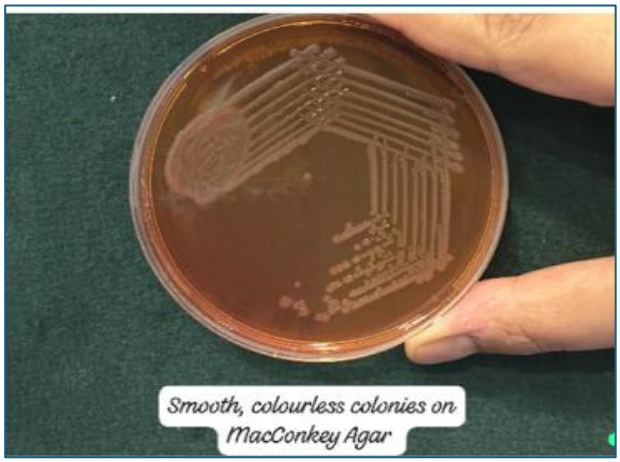

Figure 1: Proteus grown on MacConkey agar.

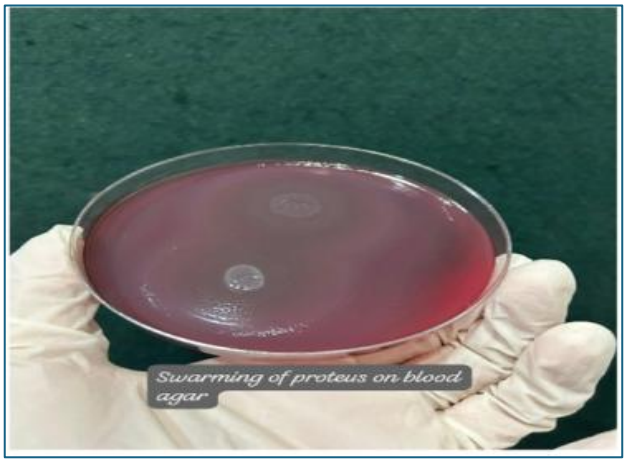

Figure 2: Proteus swarming seen on blood agar.

Management

The patient was shifted to the critical care unit and managed with: Intravenous broad-spectrum antibiotics were started empirically and adjusted as per the sensitivity report. Injection vancomycin 1 gm IV 12th hourly given for 3 days, then stopped after receiving sensitivity report. Injection meropenem 2 gm IV over 3 hours infusion 8th hourly. Injection amikacin 500 mg IV 24th hourly

All injectable antibiotics continued for 14 days in the hospital admission period. Antiepileptic therapy was given and continued. Electrolyte correction, hyperammonemia management, and supportive care was given.

The patient improved significantly over two weeks and was discharged in stable condition on oral antibiotics for 4 more weeks. On follow-up visits, she remained asymptomatic with no neurological deficits.

DISCUSSION

Postoperative meningitis following spinal surgeries typically results from Staphylococcus species, while Gram-negative meningitis is rare and carries high morbidity.[5,6] *Proteus mirabilis*, though a known uropathogen, is an uncommon cause of CNS infections, particularly in the postoperative spine surgery setting.[7-9] This patient had been treated for recurrent episodes of urinary tract infection on OPD basis multiple times before surgery. Risk factors in this case included advanced age, diabetes mellitus, and a possible urinary source of infection. Urinary tract infections may lead to hematogenous spread, particularly in immunocompromised hosts.[10] Comorbidities, especially uncontrolled diabetes, independently increases post-surgical bacterial meningitis risk by 1.5-2 times, significantly raising the likelihood of both infection and poor surgical outcomes.[11] Recent pooled data place the median mortality rate for postoperative bacterial meningitis at approximately 28% (range 20-50%). Elderly patients and those with comorbidities, such as diabetes, demonstrate particularly poor prognosis.[12-14]

Proteus mirabilis possesses natural and intrinsic resistance to several antibiotic classes, expresses extended-spectrum beta-lactamases (ESBLs) with increasing frequency. However, in systematic reviews and cohort studies, susceptibility to meropenem and amikacin remains above 95% in most global surveillance studies to date, Tunkel et al, Wolff et al and Hamid K.[15-17] The present isolate was susceptible to meropenem (MIC≤0.25, BMQ 4), amikacin (MIC 4, BMQ 1). Vancomycin was stopped as soon culture started growing gram negative bacilli to avoid drug associated side effects, nephrotoxicity and ensure antimicrobial stewardship as well the cost factor to patient.

After noting the unusual growth of gram-negative bacilli in CSF culture and blood culture, on detailed history taking, we found that she had recurrent urinary tract infection, which got treated on an out-patient basis 2 months before surgery.

Pharmacokinetic studies indicate that standard meropenem dosing (2 g IV every 8 h) achieves subtherapeutic CSF levels for many gram-negative bacilli, compounded by high inter-individual variability in CNS penetration (6-39%). Current expert recommendations support high-dose, prolonged infusions or continuous dosing in CNS infections, particularly if the MIC approaches susceptibility breakpoints or if the patient has augmented renal clearance. Monitoring of clinical and laboratory response is essential.[18-20]

Learnings from this unique case for us-prompt recognition and aggressive treatment, including tailored antibiotic therapy ensuring antimicrobial stewardship and management of metabolic derangements, are crucial for recovery. This case also highlights the necessity of close postoperative monitoring, especially in elderly patients with comorbidities. Emphasis should be given on thorough clinical workup, including urine routine and culture examination and blood culture if indicated in preoperative assessment in order to prevent any postoperative complications. Importance of history taking deserves utmost emphasis. The patient and family were relieved by the complete neurological recovery and expressed gratitude for the timely diagnosis and treatment.

CONCLUSION

This rare case emphasizes the need for high clinical suspicion and timely intervention in elderly diabetic patients presenting with atypical postoperative complications. Stringent aseptic techniques, rigorous preoperative screening for urinary tract infections, including urine and blood cultures as indicated, and optimized glucose control are vital preventive strategies in high-risk populations. Despite the rarity of *Proteus mirabilis* meningitis following spine surgery, favorable outcomes can be achieved with early, aggressive and multidisciplinary management.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Narate SS, Sharma V, Chaudhuri S, Malik P. Proteus mirabilis meningitis following lumbar spine surgery in an elderly diabetic patient: a rare case report. Int Surg J 2026;13:303-6.