

An Unusual Case of Escherichia Coli Meningitis in an Immunocompetent Adult

Review began 04/10/2023

Review ended 04/13/2023

Published 04/21/2023

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Abstract

Spontaneous meningitis caused by Gram-negative bacilli is rare in adults. It typically occurs after a neurosurgical procedure or head injury but may also be related to the presence of a neurosurgical device, cerebrospinal fluid (CSF) leak syndrome, or seen in immunosuppressed patients. *Escherichia coli* (*E. coli*) is the leading cause of Gram-negative bacilli meningitis. We describe the case of a 47-year-old man who was hospitalized for spontaneous, community-acquired *E. coli* meningitis, which is unusual to see in an immunocompetent adult. CSF analysis was consistent with bacterial meningitis; his blood culture was positive for *E. coli*. Within 24 hours of initiation of antibiotics, his status improved.

Categories: Internal Medicine, Neurology, Infectious Disease

Keywords: e. coli bacteremia, e. coli, gram-negative meningitis, bacterial meningitis, lumbar puncture, meningitis, cerebrospinal fluid, gram-negative bacillus, escherichia coli

Introduction

Bacterial meningitis is a serious infection of the meninges and can be caused by a variety of bacteria, with the most common pathogens including *Streptococcus pneumoniae*, *Neisseria meningitidis*, and *Haemophilus influenzae* [1]. In this case report, we present an unusual case of meningitis caused by *Escherichia coli* (*E. coli*) in an adult, a common bacterium usually associated with gastrointestinal and genitourinary infections. While *E. coli* is known to cause meningitis in neonates, it is a rare occurrence in adults [2]. This case highlights the importance of considering atypical causes of meningitis in patients who present with typical symptoms of the disease, even in the absence of traditional risk factors.

Case Presentation

A 47-year-old male with a past medical history significant for diabetes mellitus with haemoglobin A1c of 7.0 and hypertension presented to the emergency department (ED) for progressive altered mental status via ambulance. The patient began complaining to his wife about headaches, generalized body aches, and chills around noon that day. He had no cough, runny nose, or urinary symptoms. Late in the afternoon, the patient was not verbally responsive or able to follow commands. On arrival at the ED, the patient continued to have altered mental status with fever (T max 39.3°C). A review of systems found the patient positive for lethargy, chills, diarrhea, weakness, headache, and confusion. On exam, he was noted to be febrile with a tympanic temperature of 39.3°C, heart rate of 104 beats per minute, respiratory rate of 24 breaths per minute, blood pressure of 150/90 mmHg, and fingerstick glucose of 249 mg/dL. The patient appeared lethargic, agitated, nonverbal, and uncooperative. Glasgow Coma Scale (GCS) score was eight. Neck rigidity was present. No rash was noted. Peripheral pulses were bounding with a good capillary refill. Cardiac, lung, and abdominal exams were unremarkable. The neurological exam was non-focal. Pertinent infectious diseases history includes eating ring bologna, a finely ground pork sausage made in the form of a ring, 24 hours before the presentation that was sitting on the counter for two days.

Blood cultures and routine laboratory tests were obtained, and fluid resuscitation as per severe sepsis protocol was initiated. Piperacillin-tazobactam and vancomycin were given for sepsis of unclear source. Computed tomography (CT) of the head, with and without contrast, was negative for any acute pathology (Figure 1). A lumbar puncture was performed after antibiotics were administered. CSF was noted to be turbid. His antimicrobial regimen was adjusted to ceftriaxone, ampicillin, vancomycin, and acyclovir. Laboratory results are shown in Tables 1-2.

How to cite this article

Mir M, Hassan E, Sharaf A, et al. (April 21, 2023) An Unusual Case of Escherichia Coli Meningitis in an Immunocompetent Adult. Cureus 15(4): e37954. DOI 10.7759/cureus.37954



FIGURE 1: CT of the head with unremarkable findings

| Basic Labs | Results | Reference Range |
|---------------------|---------|----------------------------|
| White Blood Cells | 11.5 | 3.4-9.6x10 ⁹ /L |
| Hemoglobin | 14.4 | 12.2-16.6 g/dL |
| Hematocrit | 41.0 | 38.3-48.6% |
| Platelets | 172 | 135-317x10 ⁹ /L |
| Sodium | 127 | 135-145 mmol/L |
| Chloride | 90 | 98-107 mmol/L |
| Blood Urea Nitrogen | 10 | 8-24 mg/dL |
| Creatinine | 0.77 | 0.74-1.35 mg/dL |
| Calcium | 8.3 | 8.6-10.0 mg/dL |

TABLE 1: Laboratory Results

L = liter; g/dL = grams per deciliter; mmol/L = millimoles per liter; mg/dL = milligrams per deciliter

| CSF Findings | Results | Normal |
|-----------------------|-----------------|-------------------------|
| Gross Appearance | Slightly cloudy | Clear |
| Pressure | Elevated | <180 mmH ₂ O |
| Total Nucleated Cells | 195 | Adults 0-5 |
| Neutrophils | 85 | Adults 2-4% |
| Protein | 348 | 15-45 mg/dl |
| Glucose | 123 | 45-100 mg/dl |
| CSF to serum ratio | 0.48 | >0.4 |
| Gram Stain | Negative | Negative |

TABLE 2: CSF Analysis

CSF = cerebrospinal fluid; mmH₂O = millimeters of water column; mg/dl = milligrams per deciliter

Blood cultures showed growth of *E. coli* within eight hours of incubation. CSF bacterial cultures, meningitis/encephalitis PCR panel (including for *E. coli* K1), and the Strongyloides antibody were all negative (Table 3). Within 24 hours of antimicrobial therapy, his mental status started to improve.

| | Latest Reference Range & Units | 01/05/21 10:08 | 07/30/21 13:01 | 11/27/22 18:05 | 11/27/22 18:19 | 11/27/22 19:53 | 11/29/22 05:10 |
|--------------------------------|--------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Escherichia coli K1 | Negative | | | | | Negative | |
| Haemophilus influenzae | Negative | | | | | Negative | |
| Listeria monocytogenes | Negative | | | | | Negative | |
| Neisseria meningitides | Negative | | | | | Negative | |
| Streptococcus agalactiae | Negative | | | | | Negative | |
| Streptococcus pneumoniae | Negative | | | | | Negative | |
| Cytomegalovirus | Negative | | | | | Negative | |
| Enterovirus | Negative | | | | | Negative | |
| Herpes Simplex Virus 1 | Negative | | | | | Negative | |
| Herpes Simplex Virus 2 | Negative | | | | | Negative | |
| Human Herpes Virus 6 | Negative | | | | | Negative | |
| Human Parechovirus | Negative | | | | | Negative | |
| Varicella Zoster Virus | Negative | | | | | Negative | |
| Cryptococcus neoformans/gattii | Negative | | | | | Negative | |
| Strongyloides Ab, IgG, S | Negative | | | | | | Negative |
| Enterovirus PCR | Negative | | | | | Negative | |
| HSV 1 PCR, C | Negative | | | | | Negative | |
| HSV 2 PCR, C | Negative | | | | | Negative | |
| Influenza A, POCT | Negative | | | | Negative | | |
| Influenza B, POCT | Negative | | | | Negative | | |
| Resp Syncytial Virus, POCT | Negative | | | | Negative | | |
| Varicella-Zoster Virus PCR | Negative | | | | | Negative | |
| SARS CoV-2 RNA, TMA | Undetected | Undetected | Undetected | | | | |
| SARS CoV-2, PCR, Rapid, V | Undetected | | | Undetected | | | |

TABLE 3: Bacterial, viral, and fungal panel results from CSF

The isolate of *E. coli* was susceptible to ceftriaxone; hence the patient completed a 21-day course of ceftriaxone intravenously.

Discussion

E. coli is one of the most frequent organisms that cause meningitis in newborns. However, it is highly uncommon for immunocompetent adults to develop community-acquired *E. coli* meningitis, with a prevalence of one case annually documented worldwide since 1945 [3]. In contrast, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Acinetobacter* species are the most prevalent Gram-negative bacilli that cause bacterial meningitis in adult patients [4]. Therefore, community-acquired *E. coli* meningitis in immunocompetent adults is a rare occurrence, and the factors leading to this presentation should be considered for future cases.

Most cases of meningitis caused by *E. coli* have been healthcare-associated infections following head injuries or neurosurgical procedures [5]. However, spontaneous *E. coli* meningitis can occur in patients with several comorbidities [6], including chronic alcoholism, cirrhosis, human immunodeficiency virus infection (HIV), chronic obstructive lung disease, immunosuppressive medications, and diabetes mellitus [7]. Strongyloides hyperinfection syndrome can present with *E. coli* meningitis as the *Strongyloides* larva migrates from the gastrointestinal mucosa to disseminate through the body carrying *E. coli* in the process [8]. In our patient, the *Strongyloides* antibody test was negative.

Our patient presented with a headache, fever, and altered mental status. These symptoms, along with neck stiffness, raise concern for meningitis. CSF analysis showed pleocytosis with neutrophilia and elevated protein with a borderline low CSF to serum glucose ratio, which was suggestive of bacterial meningitis. The CSF Gram stain was negative; however, this is not a sensitive test to diagnose bacterial meningitis. The bacterial cultures from CSF were negative, but unfortunately, a lumbar puncture was performed after administering antibiotics (piperacillin-tazobactam). Several studies have shown that the administration of antimicrobial therapy prior to the collection of CSF samples can decrease the sensitivity of the CSF culture results [9]. In pediatric populations, antibiotics sterilize the CSF fluid as early as less than one hour after antibiotic administration [9]. Therefore, the positive blood cultures for *E. coli*, clinical presentation, and CSF findings suggest *E. coli* meningitis. The meningitis PCR panel in our patient was negative for *E. coli* K1, and *E. coli* carrying the K1 capsule antigen is responsible for 77% of neonatal *E. coli* meningitis cases. It is possible that this infection was due to an *E. coli* without the K1 antigen.

Pomar et al. [10] found that patients with Gram-negative bacilli meningitis had a death rate of 53%. In a different study, Bodilsen et al. reported a mortality rate of 36% among patients with *E. coli* meningitis, which is higher than 20% mortality with pneumococcal meningitis and 7% mortality with meningococcal meningitis [6]. This difference in Gram-negative bacilli meningitis between the studies may be related to the specific Gram-negative bacillus causing the infection and specific virulence traits of the strains responsible for the infection [11]. Although *E. coli* meningitis can result in several complications, sepsis and multi-organ failure are the most common causes of death in these cases. In our patient, the clinical course was standard due to the fast clinical improvement with antimicrobial therapy. However, this may be related to the virulence of this strain of *E. coli*. If the strain of *E. coli* in our patient had the K1 capsule antigen or other virulence factors, the patient might have had additional complications.

Conclusions

In conclusion, *E. coli* meningitis in immunocompetent adults is unusual. As seen in our patient, risk factors often include diabetes mellitus but are not limited to cirrhosis, HIV infection, chronic obstructive pulmonary disease, and chronic organ insufficiency. The overall prognosis depends on awareness of the disease and how quickly antibiotics are administered. Impaired consciousness or bacteremia are worse prognostic factors. Given the rare prevalence of this case, the risk factors leading to this presentation are important to consider for future patients.

Additional Information

Disclosures

Human subjects: All authors have confirmed that this study did not involve human participants or tissue.

Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Acknowledgements

Mikael Mir and Esraa Hassan contributed equally to the work and should be considered co-first authors. Author Contributions Mikael Mir: Conceptualization, drafting, reviewing, final editing, and agreeing to the accuracy of the work. Esraa Hassan: Conceptualization, drafting, reviewing, final editing, and agreeing to the accuracy of the work. Ahmed Sharaf: Conceptualization, drafting, reviewing, final editing, and agreeing to the accuracy of the work. Abbas B. Jama: Conceptualization, drafting, reviewing, final editing, and agreeing to the accuracy of the work. Sydney Boike: Reviewing, editing, and agreeing to the final accuracy of the work. Ibtisam Rauf: Reviewing, editing, and agreeing to the final accuracy of the work. Noura Attallah: Reviewing, editing, and agreeing to the final accuracy of the work. Cristina Corsini Campioli: Conceptualization, drafting, reviewing, final editing, and agreeing to the accuracy of the work. Eric Gomez Urena: Conceptualization, drafting, reviewing, final editing, and agreeing to the accuracy of the work. Syed Anjum Khan: Supervision, critical revision of the manuscript, editing, reviewing, and agreeing to the final accuracy of the work. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. El Bashir H, Laundry M, Booy R: Diagnosis and treatment of bacterial meningitis . Arch Dis Child. 2003, 88:615-20. [10.1136/adc.88.7.615](#)
2. Chávez-Bueno S, McCracken GH Jr: Bacterial meningitis in children . Pediatr Clin North Am. 2005, 52:795-810, vii. [10.1016/j.pcl.2005.02.011](#)
3. Kasimahanti R, Satish SK, Anand M: Community-acquired Escherichia coli meningitis with ventriculitis in an adult-a rare case report. J Intensive Care. 2018, 6:63. [10.1186/s40560-018-0332-6](#)
4. Berk SL, McCabe WR: Meningitis caused by gram-negative bacilli . Ann Intern Med. 1980, 93:253-60. [10.7326/0003-4819-93-2-253](#)
5. van de Beek D, Drake JM, Tunkel AR: Nosocomial bacterial meningitis . N Engl J Med. 2010, 362:146-54. [10.1056/NEJMra0804573](#)
6. Bodilsen J, Brouwer MC, Kjærgaard N, Sirks MJ, van der Ende A, Nielsen H, van de Beek D: Community-acquired meningitis in adults caused by Escherichia coli in Denmark and The Netherlands. J Infect. 2018, 77:25-9. [10.1016/j.jinf.2018.05.009](#)
7. Bichon A, Aubry C, Dubourg G, Drouet H, Lagier JC, Raoult D, Parola P: Escherichia coli spontaneous community-acquired meningitis in adults: A case report and literature review. Int J Infect Dis. 2018, 67:70-4. [10.1016/j.ijid.2017.12.003](#)
8. Gomez JB, Maque Y, Moquillaza MA, Anicama WE: E. coli meningitis presenting in a patient with disseminated Strongyloides stercoralis. Case Rep Infect Dis. 2013, 2013:424362. [10.1155/2013/424362](#)
9. Kanegaye JT, Soliemanzadeh P, Bradley JS: Lumbar puncture in pediatric bacterial meningitis: defining the time interval for recovery of cerebrospinal fluid pathogens after parenteral antibiotic pretreatment. Pediatrics. 2001, 108:1169-74.
10. Pomar V, Benito N, López-Contreras J, Coll P, Gurguí M, Domingo P: Spontaneous gram-negative bacillary meningitis in adult patients: characteristics and outcome. BMC Infect Dis. 2013, 13:451. [10.1186/1471-2334-13-451](#)
11. Ayerbe Algaba R, Álvarez-Marín R, Praena J, Smani Y: Escherichia coli causing meningitis in an adult: A case report and experimental characterization of its virulence. Enferm Infecc Microbiol Clin (Engl Ed). 2019, 37:418-9. [10.1016/j.eimc.2018.06.002](#)