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Case of Adult *Escherichia Coli* Meningitis

Kazuistika meningitidy dospělých způsobená bakterií *Escherichia coli*

Dear editors,
bacterial meningitis causes potentially life-threatening neurological complications [1]. In contrast to *Streptococcus pneumoniae* and *Neisseria meningitis* [2], *Escherichia coli (E. coli)* rarely causes adult meningitis, accounting for approximately 1% of meningitis cases [2,3], although this disease is a healthcare-associated infection and occurs especially after traumatic craniocerebral injury or as a neurosurgical procedure complication [4]. Furthermore, *E. coli* meningitis (EcM) patients have higher mortality rate than those with other bacterial meningitis [3,5]. However, patients admitted to long-term care facilities (LTFCs) almost always have preexisting risk factors to EcM (e.g. advanced age, cancer or diabetes mellitus history). Furthermore, their disease typically occurs secondary to a distant or contiguous infection focus (e.g. urinary tract or gastrointestinal infection or otitis media) [3,5]. However, reported cases of adult EcM in LTFCs are limited.

We describe a case of a 49-year-old man admitted at a LTCF who previously suffered from cerebral vascular accident with multiple infarction haemorrhages over the right cerebellum and respiratory failure. He had hydrocephalus and neurogenic bladder and underwent ventriculoperitoneal (VP) shunting and cystostomy, respectively, as treatments 6 years ago. He was admitted to our institute because of changes in consciousness and low blood pressure. Initially, he had a body temperature of 38.6 °C, pulse rate of 132/min and blood pressure of 80/50 mm Hg; his respiratory rate was equivalent to the ventilator rate. Neurological examination was difficult to perform but no significant abnormalities (e.g., meningeal signs) or new neurological deficits were observed. Physical examination of the respiratory system revealed coarse breathing sounds. Laboratory results on the 1st admission day showed markedly increased white blood cell (WBC) count (12,200/μL), C-reactive protein (7.65 mg/dL), and serum glucose levels (160 mg/dL). No definite new and active lung lesion was observed on the initial chest imaging. However, brain computed tomography (CT) displayed one left prefrontal ovoid lesion (size 31 mm). Hence, an immediate lumbar puncture was conducted. Cerebral spinal fluid examination revealed WBC, protein, and glucose levels of 1,120/cm^3, 192 mg/dL (normal range, 15–45 mg/dL), and 2 mg/dL (normal range, 40–70 mg/dL), respectively. A central nervous system infection was suspected; antimicrobial treatment with ceftazidime (2 g intravenous (IV) every 8 hours) and vancomycin (500 mg IV every 6 hours) was started. On the 2nd admission day, *E. coli* was identified from blood and CSF specimens using matrix-assisted laser desorption/ionization-time-of-flight mass spectrometry (bioMérieux, Hazelwood, MO). An antimicrobial drug susceptibility test [6] was conducted through the bioMérieux VITEK 2 system (bioMérieux). The minimal inhibition concentration levels were listed at Tab. 1 (Supplementary Tab. 1 online). After pathogen identification, we performed additional diagnostics to identify the primary infection focus. Although the patient was vegetarian, his past medical history showed absence of significant predisposing factors (e.g., previous EcM), except for craniotomy and VP shunting. Furthermore, chest X-ray revealed old lesions, and abdominal lesions were detected during the brain CT conducted at admission. However, these results did not reveal the primary focus. Thus, gallium scan was initially performed, followed by pelvis CT. The CT findings indicated abscess formation in the left psoas muscle and pericecal region that was complicated with fluid collection around the left abdominal wall and the VP shunt catheter tip. Thus, emergent operation was performed to aspirate the psoas muscle abscess under sonographic guidance. Furthermore, abdominal wall abscess debridement and VP shunt removal were conducted. The abdominal abscess culture showed polymicrobes (e.g., *E. coli*, *Klebsiella pneumoniae*, and *Candida albicans*). The antimicrobial regimen was changed from ceftazidime and vancomycin to imipenem-cilastatin (250 mg IV every 8 hours) and fluconazole (200 mg IV daily). However, imipenem-cilastatin was replaced with meropenem (2 m IV every 8 hours) because of a tonic-clonic seizure attack after 5 days of medication administration. Despite the treatment, the patient's condition deteriorated. Specifically, he required mechanical ventilation that

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Ch. Chang-Hua[1], Y. Hua-Cheng[2], L. Li-Jhen[3]

[1] Division of Infectious Disease, Department of Internal Medicine, Changhua Christian Hospital, Changhua, Taiwan
[2] Department of Neurosurgery, Changhua Christian Hospital, Changhua, Taiwan
[3] Infection Control Committee, Changhua Christian Hospital, Changhua, Taiwan

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Chen Chang-Hua, MD
Division of Infectious Disease
Department of Internal Medicine
Changhua Christian Hospital
Nanhsiao Street
Changhua 500
Taiwan
e-mail: 76590@cch.org.tw

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Tab. 1. Evidence-based literature review of risk factors and management of adult *E. coli* meningitis.

Author/study year/country (reference)	Study design/ clinical setting	Number of enrolled patients (characteristics of enrolled patients)	Microbiology; isolates number (% if available) /type of infection	Antimicrobial agents (dose, and interval) for duration of therapy (no. of patients)	Predisposing factors	Outcome (all-cause mortality rate)
This case	case report/ single hospital	1	*E. coli*/HAI[a]	MEM (6 g/day) for 21 days (1)	Csurg	died
Ishida et al./2016/ Japan*	case report/ single hospital	1	*E. coli*/CAI[b]	CTX (1)	negative	cured
Kohlmann et al./ 2015/Germany*	case report/ single hospital	1	CTX-M-9 type ESBL-producing *E. coli*/CAI	MEM (6 g/day) for 21 days (1)	NM	cured
Yoshino et al./ 2013/Japan*	case report/ single hospital	1	ESBL-producing *E. coli*/CAI	MEM (1 g/day) (1)	NM	died
Gomez et al./ 2013/Peru*	case report/ single hospital	1	ESBL-producing *E. coli*/HAI	MEM with AMK (IV)	CTC	died[c]
Elaldi et al./2012/ Turkey*	case report/ single hospital	1	CTX-M-15-type ESBL-producing *E. coli*/CAI	MEM (3 g/day) plus AMK (1.5 g/ day IV)	COM; CSFfis, Csurg	cured[d]
Weyrich et al./ 2012/France*	case report/ single hospital	1	ESBL-producing *E. coli*/CAI	MEM (6 g/day) for 21 days (1)	ACH, AAA	cured[e]
Khan et al./2007–2010/ Qatar*	case report/single hospital	1	ESBL-producing *E. coli* (2); non-ESBL-producing *E. coli* (2)/HAI	MEM for 16.5 days (range, 6–24 days; mean, 16.5 days) (1)	trauma	two of the four patients (50%) died
Teckie et al./ 2007–2009/South Africa*	retrospective cohort/ single hospital	26 (spontaneous adult meningitis)	*E. coli* (9, 34.6%)/ NM	NM	HIV infection	65%
Sule et al./2007/ Singapore*	case report/ single hospital	1	*E. coli*/CAI[b]	CRO (2 g q 12 h) for 14 days (1)	HTN, ISHD	cured
Fujitani et al./ 2005/USA*	case report/ single hospital	1	*E. coli*/CAI	NM	NM	died
Wang et al./ 2003–2011/ Taiwan*	retrospective cohort/ single hospital	109 (postneurosurgical procedure)	*E. coli* (11, 8.7%)/ NM	NM	NM	26.7%[f]
Mofredj et al./ 2000/France*	case report/ single hospital	1	*E. coli*/CAI	NM	NM	NM
O'Neill et al./ 1998–2004/ Ireland*	retrospective cohort/ single hospital	34 (neurosurgical patients)	*E. coli* (8, 22.5%)/ NM	NM	NM	2.5% (mortality directly caused by meningitis)[g]
Briggs et al./ 1990–2001/New Zealand*	retrospective cohort/single hospital	33 (neurosurgical patients)	*E. coli* (6, 18.2%)/ NM	–	NM	15%[h]
Bouadma et al./ 1988–2003/ France*	retrospective cohort/ multicenter	40 (admitted to ICU)	*E. coli (23)/NM*	NM	NM	38%[i]
Yang et al./ 1986–2003/ Taiwan*	retrospective cohort/ single hospital	306 (*E. coli* meningitis)	*E. coli* (15/306, 5%)/NM	NM	postneurosurgical state	27%[j]
Pomar et al./ 1986–2006/ Spain*	retrospective cohort/ single hospital	544 (spontaneous acute bacterial meningitis)	*E. coli* (15, 38%)/ HAI	NM	elderly, cancer, NAcq, priorUTI	53%

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Tab. 1 – continuing. Evidence-based literature review of risk factors and management of adult *E. coli* meningitis.

Author/study year/country (reference)	Study design/ clinical setting	Number of enrolled patients (characteristics of enrolled patients)	Microbiology; isolates number (% if available) /type of infection	Antimicrobial agents (dose, and interval) for duration of therapy (no. of patients)	Predisposing factors	Outcome (all-cause mortality rate)
Wang et al./ 1986–2001/ Taiwan*	retrospective cohort/single hospital	62 (postneurosurgical patients)	*E. coli* (5, 8.7%)/NM	NM	NM	NM[k]
Emele/ 1987–1992/ Nigeria*	retrospective cohort/single hospital	289	*E. coli* (2, 0.7%)/NM	NM	NM	NM
Chotmongkol et al./1984–1998/ Thailand*	retrospective cohort/single hospital	85	*E. coli* (12, 14%)/NM	NM	NM	34%
Gower et al./ 1976–1984/North Carolina*	retrospective cohort/single hospital	39	NM	NM	NM	35.9%

AAA – aortic mycotic aneurysms; Abx – antibiotics; ACH – alcoholism; AMK – amikacin; CAI – community-associated infection; CIP – cipro-floxacin; COM – chronic otitis media; CRO – ceftriaxone; CSFfis – cerebrospinal fluid fistula; Csurg – cranial surgery; CTC – corticosteroids; CTX – cefotaxime; ESBL – extended-spectrum β-lactamase; HAI – healthcare-associated infection; HTN – hypertension; ICU – intensive care unit; ISHD – ischemic heart disease; MEM – meropenem; NAcq – nosocomial acquisition; NM – not mentioned; priorUTI – urinary tract infection as distant focus of infection; trauma, accidental and neurosurgical trauma of the head and spine.

[a] Although the CSF culture was negative in our patient, *E. coli* was detected in his blood and urine cultures.

[b] Although CSF culture was negative, we diagnosed and treated the condition as *E. coli* meningitis based on the results of the CSF analysis and positive blood culture.

[c] Principal conclusion from this reference: *Strongyloides stercoralis* infection should be excluded in adults with spontaneous *E. coli* meningitis, especially if the patient experienced gastrointestinal symptoms and had a history of traveling to an endemic area.

[d] Principal conclusion from this reference: Empiric antibiotic therapy with carbapenem can be started before the culture results are obtained, primarily in areas where ESBL epidemiology is well known.

[e] Meningitis was cured, but the patient died during an operation.

[f] Principal conclusion from this reference: IV antibiotic therapy is a useful treatment for postneurosurgical Gram-negative bacillary meningitis or ventriculitis.

[g] Principal conclusion from this reference: The median duration of treatment was 19.2 days, and 20% of cases were caused by organism resistant to the third-generation cephalosporins.

[h] Principal conclusion from this reference: Recommended initial treatment was IV ceftriaxone and amikacin. Treatment for at least 14 days after the last positive CSF culture guaranteed cure.

[i] Principal conclusion from this reference: Five patients had strongyloidiasis, and 40% of *E. coli* were resistant to aminopenicillins.

[j] Principal conclusion from this reference: Diabetes mellitus and post-neurosurgical status were the common predisposing factors. *E. coli* meningitis that are not susceptible to third-generation cephalosporin have emerged since 2001.Four patients who were not administered with appropriate antibiotic treatment died, and the other 11 patients were given appropriate antibiotic treatment.

[k] Principal conclusion from this reference: Nine out of 62 organisms were resistant to third-generation cephalosporins. Increase incidence of oxacillin-resistant *Staphylococcus* infection was observed in patients with postneurosurgical nosocomial meningitis.

* Complete list of references online only.

resulted in ventilator-associated pneumonia. His general condition continued to worsen and this had prompted his family to request discharge due to medical futility.

We report the first case of an adult EcM from a LTCF in Changhua County. Some studies on healthcare-associated meningitis reported that patients are particularly prone to this disease because of subsequent microorganism penetration owing to traumatic craniocerebral injury or neurosurgical procedures [2,4,5]. In our patient, there was an evidence of possible healthcare-associated meningitis, in which *E. coli* originated from the psoas muscle abscesses and was transmitted via the VP shunt. Considering that adult EcM is rarely suggested as a cause of a central nervous system infection, we conducted an evidence-based literature review. Worldwide, 112 adult patients with EcM were reported (Supplementary Tab. 2 online). The crude mortality rate ranged from 65% [7] to 2.5% [8]. The majority of EcM cases was observed in patients with predisposing risk factors, such as advanced age [5], cancer history [5], nosocomial acquisition [5], cerebrospinal fluid fistula [9], cranial surgery [9], chronic otitis media [9], and trauma [10]. However, our patient did not display any of these risk factors except from craniectomy and VP shunt insertion 7 years

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ago. Moreover, approximately 75% of the cases [3,4] occurred secondary to a distant or contiguous infection (e.g. urinary tract infection). Thus, the diagnostics in this case were extended after pathogen identification to identify the primary infection focus, resulting in the diagnosis of previously unrecognized psoas muscles abscesses. Consequently, our report emphasizes the importance of searching for the source of adult EcM, especially if no typical risk factors are identified.

EcM in adult patients is a rare and fatal disease that usually has risk factors. Performing an extended diagnostic examination to exclude underlying diseases and possible precedent infections is advised if no typical risk factors or the original focus are identified.

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