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Case report

Campylobacter fetus meningitis associated with eating habits of raw meat and raw liver in a healthy patient: A case report and literature review

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ABSTRACT

Meningitis caused by the zoonotic pathogen *Campylobacter fetus* in immunocompetent adults is rare. We report a 48-year-old Japanese woman with no underlying disease who was found to have meningitis caused by *C. fetus*. Both *C. fetus* subsp. *fetus* and *C. fetus* subsp. *venerealis* were isolated from the cerebrospinal fluid culture. The mode of infection in our patient was considered to be associated with the consumption of raw beef and raw cattle liver on a regular basis. Public awareness and education to avoid the consumption of raw or undercooked meat might help prevent *C. fetus* meningitis.

Introduction

Campylobacter fetus (formerly called as *Spirillum serpens* or *Vibrio fetus*) is a zoonotic pathogen with major reservoirs of cattle and sheep. *C. fetus* is a rare cause of bacterial meningitis. Thus far, C. *fetus* meningitis has been reported to occur in those who frequently chew khat (an alkaloid containing plant) in an animal sanctuary, come in contact with domestic animals, or consume the raw meat or raw liver of cattle and sheep [1].

C. fetus infections frequently occur among patients with impaired immunity including conditions such as chronic alcoholism, liver disease, old age, diabetes mellitus, and malignancies [2]. There are only a few case reports of *C. fetus* bacteremia and meningitis in healthy adults [3–6]. However, immunosuppression may not be the sole risk factor [7]. In this study, we report a case of *C. fetus* meningitis in a healthy adult and conducted a literature review.

Case

While in the emergency department of our hospital, she was alert and oriented, and not in acute distress. Her blood pressure was 132/60 mmHg, her heart rate was 64/min, her respiratory rate was 30/min, and her body temperature was 38.4 °C. The physical examination revealed nuchal rigidity without focal neurological abnormalities. Her laboratory tests revealed a white blood cell count of 14,200/μL; she tested negative for human immunodeficiency virus (HIV) antigens and antibodies and her electrolyte and aminotransferase levels were within normal limits. Cerebrospinal fluid (CSF) testing revealed leukocytosis with high protein and low glucose levels (Table 1). Her CSF showed increased white blood cells with neutrophil dominance with no organisms seen on Gram stain. Dexamethasone, ceftriaxone, ampicillin, vancomycin, and acyclovir were administered to treat both bacterial and viral meningitis. In addition, minocycline was administered to treat rickettsiosis. The serum cryptococcal antigen and serum nontreponemal and treponemal tests were negative. The acid-fast bacilli smear test and tuberculosis polymerase chain reaction (PCR) of the CSF were both negative.

On day three of admission, the patient's headaches began to recede. Vancomycin and dexamethasone were discontinued as meningitis due to *Streptococcus pneumoniae* was thought to be less likely as the CSF cultures were negative. On day five of admission, Gram-negative spiral

Table 1
Cerebrospinal fluid test.

Leukocytes	1219/μL
Polynuclear cells	799/μL (65%)
Mononuclear cells	418/μL (34%)
Protein	80 mg/dL
Glucose	51 mg/dL
(Blood glucose)	134 mg/dL

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Table 2
Summary of previously reported *Campylobacter fetus* meningitis.

Case no.	Year	Author	Country	Age	Sex	Underlying conditions	Cause	Bacteriology	Method to identify the organism	Blood culture	CSF culture	Outcome
1	1960	Edwards CE	United States	50	F	Hypertention	Handling fecal discharges of rats	*Spirillum serpens*	Biochemical	+	+	Cured
2	1964	Collins S	United States	55	M	Chronic lymphatic leukemia	Unknown	*Vibrio fetus*	Biochemical	+	+	Relapsed → Cured
3	1966	Killam H	United States	48	F	Healthy	Frequent contact with domestic animals	*Vibrio fetus*	Biochemical	+	–	Hemiparesis
4	1969	Reyman TA	United States	69	F	Diabetes mellitus, Thrombocytopenia	Unkown	*Vibrio fetus*	Biochemical	+	+	Died
5	1971	Gunderson CH	United States	53	M	Drug abuse	Unknown	*Vibrio fetus*	Biochemical	+	+	Deeply comatose
6	1976	Gubina M	Yugoslavia	46	M	Healthy	Frequent contact with domestic animals	*C. fetus subsp. intestinalis*[a]	Biochemical	+	–	Cured
7	1976	Gubina M	Yugoslavia	40	M	Healthy	Frequent contact with domestic animals	*C. fetus subsp. intestinalis*[a]	Biochemical	–	+	Cured
8	1978	Zelinger KS	United States	50	M	Healthy	Handling raw meat	*Vibrio fetus*	Biochemical	+	–	Cured
9	1984	Hanai N	Japan	53	M	Liver dysfunction	Unknown	*C. fetus subsp. fetus*	Biochemical	+	+	Cured
10	1985	Fracioli P	Switzerland	68	M	Adenocarcinoma of rectum with hepatic metastasis	Unknown	*C. fetus subsp. fetus*	Biochemical	+	+	Died
11	1985	Fracioli P	Switzerland	65	M	Alcoholic cirrhosis	Unknown	*C. fetus subsp. fetus*	Biochemical	+	–	Relapsed → Cured
12	1986	Iida Y	Japan	30	M	Healthy (Appendectomy history, Herniated disc)	Ingesting raw cattle liver	*C. fetus subsp. fetus*	Biochemical	–	+	Cured
13	1986	Iida Y	Japan	42	M	Healthy	Unknown	*C. fetus subsp. fetus*	Biochemical	–	+	Cured
14	1986	Yamazaki E	Japan	53	M	Healthy	Unknown	*C. fetus subsp. fetus*	Biochemical	+	+	No data
15	1986	Yamazaki E	Japan	53	M	Healthy	Unknown	*C. fetus subsp. fetus*	Biochemical	+	+	No data
16	1987	Rao KV	United States	47	M	Cadaver kidney transplant recipient	Ingesting raw cattle liver	*C. fetus subsp. intestinalis*[a]	Biochemical	+	+	Cured
17	1990	Kato H	Japan	55	M	Chronic alcoholism, Diabetes mellitus, Lung tuberculosis	Unknown	*C. fetus*	Biochemical	–	+	Cured
18	1993	Inoue Y	Japan	40	M	Healthy (Appendectomy history)	Ingesting raw beef	*C. fetus subsp. fetus*	Biochemical	–	+	Cured
19	1996	Dronda F	United States	47	M	Chronic alcoholism, Previous infection with HBV	Unknown	*C. fetus subp. fetus*	Biochemical, PCR	+	+	Relapsed → Cured
20	1998	Ozeki T	Japan	49	M	Alcoholic liver disease	Unknown	*C. fetus subsp. fetus*	Biochemical	+	+	Hemiparesis
21	2002	Herve J	France	71	M	Diabetes mellitus	Unknown	*C. fetus subsp. fetus*	Biochemical, 16S rRNA gene sequencing	+	+	Cured
22	2004	Shioyama M	Japan	43	M	Healthy	Unkown	*C. fetus*	Biochemical	–	+	Cured
23	2006	Kanayama S	Japan	51	M	Healthy	Unkown	*C. fetus subsp. fetus*	Biochemical	+	+	Cured
24	2008	Umehara Y	Japan	40	M	Crohn's disease	Unkown	*C. fetus*	Biochemical	+	+	Cured
25	2010	Martínez-Balzano C	United States	28	M	Healthy	Khat chewing	*C. fetus subsp. fetus*	16S rRNA gene sequencing	+	–	Cured
26	2013	Suy F	France	75	M	Diabetes mellitus, Adenomatous sigmoid polyps	Ingesting raw sheep liver	*C. fetus subsp. fetus*	MALDI-TOF-MS, 16S rRNA gene sequencing	+	+	Cured
27	2016	van Samkar A	The Netherlands	23	F	Healthy	Frequent contact with domestic animals	*C. fetus subsp. fetus*	No data	–	+	Concentration problems
28	2016	van Samkar A	The Netherlands	52	M	Healthy	Frequent contact with domestic animals	*C. fetus subsp. fetus*	No data	+	+	Relapsed → Cured
29	2017	Present case	Japan	48	F	Healthy	Ingesting raw beef and cattle liver	*C. fetus subsp. fetus/ venrealis*	No data	+	+	Relapsed → Cured

[a] *C. fetus* subsp. *fetus* is formerly described as *C. fetus* subsp. *intesinalis* [10].

bacilli were isolated from the CSF culture. Acyclovir, ampicillin, and minocycline were discontinued, and only ceftriaxone was continued. On day 12 of admission, matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF-MS) identified the organisms isolated from the CSF specimen as *C. fetus* subsp. *venerealis* (score 2.378) and *C. fetus* subsp. *fetus* (score 2.334). At this point, repeated history taking revealed that she had been consuming raw beef and raw cattle liver every weekend. Thus, the diagnosis of *C. fetus* as a cause of meningitis was made.

Ceftriaxone was changed to meropenem as she developed generalized skin rash most likely as a side-effect of ceftriaxone. She was discharged home after she received four weeks of intravenous antimicrobial treatment, and she did not show any signs of recurrence. 16S rRNA gene sequencing was performed to confirm the identification of the organisms. Gene sequencing revealed 100% coincidence with *C. fetus* subsp. *venerealis* and 99% coincidence with *C. fetus* subsp. *fetus*.

Discussion

A literature search in Pubmed was performed, and all clinical cases of *C. fetus* meningitis in adults published in English and Japanese were reviewed. The following keywords were used: "meningitis AND *Campylobacter fetus*," "meningitis AND *Vibrio fetus*," and "*Spirillum serpens* AND meningitis." The major findings are summarized in Table 2.

Two subspecies of *C. fetus* were identified: *C. fetus* subsp. *fetus* and *C. fetus* subsp. *venerealis*. *C. fetus* subsp. *fetus* is associated with abortion in cattle and sheep and also causes infections in humans [2]. Conversely, *C. fetus* subsp. *veneralis* is associated with abortion in cattle [8], but its role in humans is uncertain. *C. fetus* subsp. *veneralis* has only been isolated from the stools of two homosexual men in Australia and from two women with bacterial vaginosis [2].

Our literature review revealed that all cases of meningitis were caused by *C. fetus* subsp. *fetus*. Our patient was unique as her CSF culture showed two subspecies: *C. fetus* subsp. *fetus* and *C. fetus* subsp. *venerealis*. MALDI-TOF-MS and 16S rRNA gene sequencing identified both subspecies. We considered two hypotheses. One was that our patient was infected by both the subspecies *C. fetus* subsp. *fetus* and *venerealis*. The other was that MALDI-TOF-MS and 16S rRNA gene sequencing failed to distinguish the two subspecies. Differentiation between the two subspecies has traditionally been determined by the 1% glycin tolerance test, and PCR assays have also been reported as a valuable adjunctive technique [9]. We did not perform these tests; however, *C. fetus* subsp. *venerealis* reported a higher score on performing MALDI-TOF-MS and a higher coincidence on performing 16S rRNA gene sequencing. *C. fetus* subsp. *venerealis*, an extremely rare organism to cause infections in humans, could be the pathogen that caused meningitis in our patient.

Another remarkable point in our literature review is that five patients were infected by consuming raw meat or raw liver and that three of them were Japanese with no past medical history, including our patient. It is not a rare occasion for people in Japan and other Asian countries to consume raw beef and raw cattle liver. Therefore, eating habits can be a major risk factor for these people even if they are immunocompetent.

In 2012, the Japanese Ministry of Health, Labour and Welfare prohibited serving raw cattle liver at restaurants. However, self-barbecue restaurants still provide raw meat and raw liver, and there are no legal restrictions regarding how restaurant customers cook raw meat and raw liver that was provided. Public awareness and education to prevent *C. fetus* meningitis should be warranted not only in Japan but also in other Asian countries where these eating habits exist.

Conflict of interest

All authors do not have any conflict of interest.

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Appendix A

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