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Case Report

Conglomerate ring and tract-like enhancement lesions: Neuroimaging in *Listeria monocytogenes* brain abscess ☆,☆☆

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ABSTRACT

This report aims to describe a characteristic neuroimaging of *Listeria monocytogenes* brain abscess in predisposed patients. A 56-year-old man presented with fever and headache for 3 weeks. Cerebrospinal fluid (CSF) revealed pleocytosis with lymphocytosis, high protein, and low glucose. Both hemoculture and CSF culture yielded *L monocytogenes*. Another case is a 23-year-old woman with systemic lupus erythematosus, who presented with fever, headache and left hemiparesis. CSF showed pleocytosis with polymorphonuclear cells predominance and low glucose. Hemoculture positive for *L monocytogenes*. Their MRI brain revealed conglomerate ring and tract-like enhancement lesions at the right parietotemporal lobe. The patients were diagnosed with *L monocytogenes* brain abscess. They received a high dose of ceftriaxone and ampicillin for 6 weeks. The clinical and MRI at the end of treatment was a substantial improvement. Our information can help the physician concern about this pathogen in patients who presented with brain abscess and had these MRI findings.

Introduction

L monocytogenes is 1 of the common causes of bacterial meningitis in adults. The mortality is high, even with prompt and proper antibiotic treatment [1]. One of the critical complications is brain abscess, although it rarely occurred. The previous study found that 11% of listeria infections eventually developed abscesses [2]. The current guideline recommends ampicillin-based empirical antimicrobial treatment for the patient with risk factors, including age >50 years, alcoholism and immunocompromised host status [3]. The definite diag-

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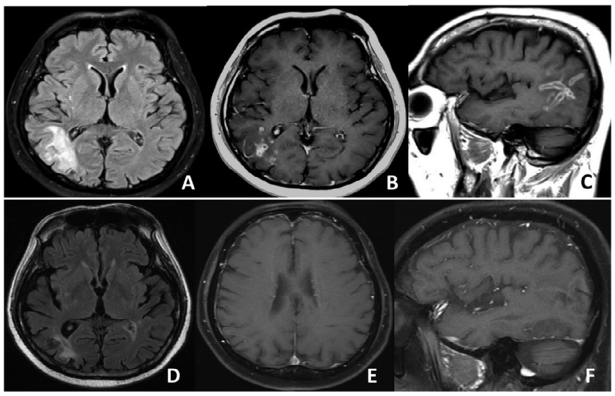

Fig. 1 – The brain MRI of the first patient: (A) axial fluid-attenuated inversion recovery (FLAIR), (B) axial, and (C) sagittal post-contrast T1-weighted (T1W) revealed tract-like enhancing lesions at the right parietotemporal lobe with surrounding vasogenic brain edema. (D) Axial FLAIR, (E) axial, and (F) sagittal post-contrast T1W of the follow-up MRI after complete treatment showed improvement and no area of residual enhancement

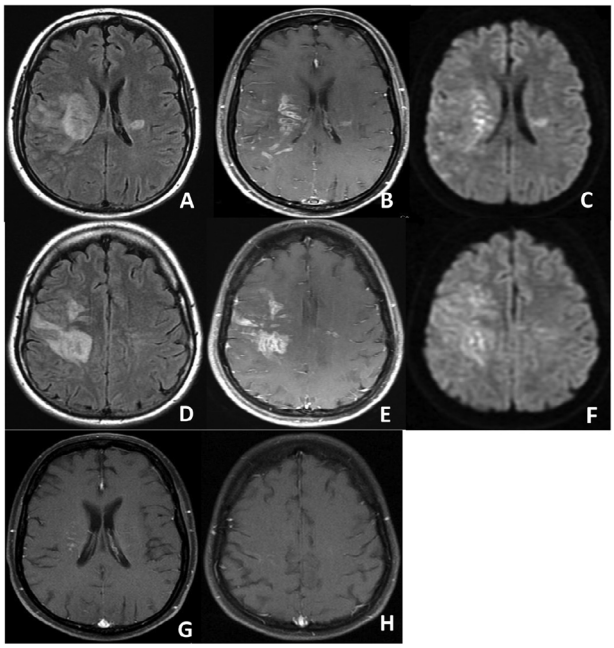

Fig. 2 – MRI brain of the second patient showed the area of vasogenic brain edema at right frontal lobe and corona radiata on FLAIR (A, D) with multiple tract-like enhancement after contrast administration (B, E). Central restricted diffusion within these lesions is seen on DWI (C, F). At the end of treatment, the follow-up MRI brain demonstrated marked improvement of the enhanced lesions in the right corona radiata (G) and the right frontal lobe (H) on T1W with gadolinium

nosis required isolation of *L monocytogenes* from the blood (sensitivity 48%) and stereotactic brain aspiration culture in abscess formation. In comparison, cerebrospinal fluid (CSF) culture sensitivity is 25% – 40% [4].

The common magnetic resonance imaging (MRI) findings are meningitis and rhombencephalitis (involving brainstem and cerebellum) but rarely report the abscess's characteristic feature [5]. Our cases in which one case confirmed by positive both blood and CSF culture – MRI finding is the conglomerate ring and tract-liked enhancement. Another patient with similar MRI findings and confirmed diagnosis by positive blood culture also responds to ampicillin-based empirical treatment. The conglomerate ring-enhancing lesions are usually reported in the central nervous system (CNS) tuberculoma or parasitic infection (eg, neurocysticercosis, sparganosis) and rarely in cerebral melioidosis [6, 7]. This present case report highlights the possibility that *L monocytogenes* brain abscess is one differential diagnosis of the conglomerate ring and tract-like enhancement in MRI findings.

Case presentation

Case 1

A 56-year-old Thai man with a history of hypertension, type 2 diabetes and lacunar syndrome presented with 3 weeks of headache, low-grade fever and an aggressive personality. Physical examination was drowsiness and fever 38.6 °C. At the first hospital, MRI brain found abnormal enhancing lesions with surrounding brain edema at the right parietotemporal lobe (shown in Fig. 1 A andC). Laboratory findings included a white blood cell (WBC) count of 20,200 cells/mm^3 with polymorphonuclear cell (PMN) predominantly 88% and anti-HIV was non-reactive. The CSF analysis revealed the following abnormalities: open pressure 13 cmH_2O, WBCs 908 cells/mm^3 (66% lymphocytes, 34% neutrophils); protein level 320 mg/dL; glucose level 5 mg/dL (blood glucose 324 mg/dL). No organism was found on Gram, Acid-Fast Bacilli (AFB), modified AFB (mAFB), India ink and Wright's stains. Empirical antimicrobial treatment was started with intravenous ceftriaxone 2 g every 12 hours and ampicillin 2 g every 4 hours. The culture result issued on the third day after admission showed *Listeria monocytogenes* from both blood and CSF.

Case 2

A 23-year-old Thai woman diagnosed with systemic lupus erythematosus (SLE) with lupus nephritis (LN) class IV. She was prescribed prednisolone 50 mg/day concomitant with mycophenolate mofetil 2 g/day for three months. She presented with a headache and high-grade fever for 3 days. After admission, she developed left hemiparesis and physical examination showed a body temperature of 38.7°C, left hemiparesis, and positive nuchal rigidity. Complete blood count showed a WBC count of 19,200 cells/mm^3 with PMN predominantly 80.5%. The MRI brain revealed multiple conglomerate ring and tract-like enhancement lesions at the right frontal lobe with extension into the insula, right basal ganglia and right posterior limb internal capsule. Some lesions are seen at the left corona radiata and left centrum semiovale (shown in Fig. 2

A andF). The CSF study showed an opening pressure of 26 cmH_2O, WBC of 282 cells/mm^3 (98% PMNs, 2% lymphocyte), the protein of 46 mg/dl, the glucose of 57 mg/dl (blood glucose 146 mg/dl) and no organism found on Gram, AFB, mAFB, India ink and Wright's stains. Cryptococcal antigen titer is negative.

The patient was empirically treated with intravenous ceftriaxone 2 g every 12 hours and ampicillin 2 g every 4 hours to coverage *L monocytogenes* due to her altered immune status. Two samples of blood culture were taken before initiation of antimicrobial therapy. They yielded gram-positive bacilli on an initial day, which finally reported *L monocytogenes* for 2 specimens.

Outcome and follow-up

In the first case, the neurological status improved to be awake and oriented on the second day after empirical antimicrobial therapy. The antimicrobial continued for 6 weeks. The follow-up MRI on the 6th week after treatment (shown in Fig. 1 D andF) showed the disease's regression and no area of residual enhancement. There is no neurological deficit on three months follow-up at the outpatient department. For the second case, the brain's second MRI was performed6 weeks after treatment and revealed significant improvement of the previously seen conglomerate ring and tract-like enhancement lesion (shown in Fig. 2 G andH). The antimicrobial therapy continued for 6 weeks resulting in the abscess's resolution. The patient had substantial improvement without residual neurological deficit.

Discussion

L monocytogenes is an intracellular, non-sporulating, gram-positive bacillus that grows on blood agar and produces incomplete beta hemolysis. It has been 1 of the most critical microorganisms transmitted by the foodborne route. *L. monocytogenes* causes clinical features of intracranial infection and sepsis in cell mediated-immunocompromised individuals (eg, individuals with an elderly with age >50-year-old, alcoholism and altered immune statuses such as acquired immunodeficiency syndrome (AIDS) patients, transplant patients, or patients receiving chemotherapy) [8]. The manifestation of listerial intracranial infection ranges from meningitis to cerebritis and focal parenchymal involvement [5]. Listerial brain abscess prefers the brainstem and brain abscess of the cerebral hemisphere is extremely rare, accounting for approximately 1% – 10% of listerial CNS infections [9].

MRI does not have a specific pattern for the abscess but usually presents with ring enhancement [10]. The conglomerate ring and tract-like enhancement lesions or worm-like appearances are the MRI finding patterns commonly seen in CNS tuberculoma, parasitic infection, especially for sparganosis, or rarely in cerebral melioidosis, not typical for the listerial brain abscess [11, 12]. From the review literature, we found three recent case series about this atypical MRI finding. Indira DeJesus-Alvelo and Amedeo Merenda in 2015 report one case of *L monocytogenes* abscess, which proved diagnosed by brain biopsy, presenting as cortically predominant ring-enhancing lesions in an elderly female with type 2 diabetes [13]. The next one is a case report by S. Ittichai *et al*. in 2016 [10]. They reported a 35-year-old female with SLE taking 30 mg/day of prednisolone and was diagnosed with *L monocytogenes* brain abscess by surgery that have MRI mimicking the track of a migrating worm like a sparganum. The most recent *L monocytogenes* brain abscess with tunnel-sign on MRI brain comes from Ondřej Slezák *et al*. in 2020. They reported three brain abscess cases caused by *L monocytogenes* with these characteristics radiological findings. Interestingly, one of three is a middle-aged immunocompetent woman whose MRI demonstrated multiple worm-like prominences and a thin rim of enhancement [14]. Our case report supports listerial brain abscess data that can present with conglomerate ring and tract-like enhancement appearances.

Conclusion

In conclusion, the lesson learned from our report reminds clinicians to think of listerial brain abscess in differential diagnosis from tuberculoma, parasitic CNS infection and cerebral melioidosis that presented MRI finding the conglomerate ring and tract-like enhancement. Antimicrobial susceptibility data revealed high *in vitro* susceptibility for penicillin (97.6%) and ampicillin (90.7%) [15]. Therefore, ampicillin should be considered an empirical antimicrobial treatment for all older adults more than 50 years or with significant immunocompromised status who suspected pyogenic brain abscesses and have these characteristics radiological appearances. More cases and studies are needed to establish the confirmation of this finding.

Learning points

- *L monocytogenes* is a serious CNS infection in the vulnerable host, including the eldery, alcoholism, or immunocompromised patients.
- Although some cases can present with rhombencephalitis, there is no MRI-specific pattern in listeriosis.
- The conglomerate ring and tract-like enhancement lesions or worm-like appearances typically found in CNS tuberculoma, parasitic infection, are increasing reports in several *L monocytogenes* brain abscesses.
- Physicians should keep listeriosis in the differential diagnosis for patients with compatible clinical settings, which encourages empirical treatment with ampicillin.

Patient consent

Written informed consent was obtained from the patients for publication of this case report and accompanying images.

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