

# Brain Abscess Caused by *Listeria monocytogenes* with An Unlikely Evolution: Case Report and Literature Review

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## ABSTRACT

**Introduction:** *Listeria monocytogenes* (LM) is an anaerobic gram-positive bacillus, that enters the host body mainly through the intestine. Brain abscesses due to LM are extremely rare and are mostly seen in patients with risk factors.

**Case report:** We present the case of a 70-year-old patient with a history of rheumatoid arthritis who presented an acute neurological deficit, with no headaches or fever. The diagnosis was confirmed after an open surgical biopsy. The patient underwent ampicillin treatment for four weeks, with an unfavorable evolution.

**Conclusion:** *L. monocytogenes* brain abscess is an uncommon pathology, with a poor prognosis. Surgery combined with antibiotics improves the outcome.

**Keywords:** Brain abscess, *Listeria monocytogenes*, MRI, neurolisteriosis.

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## 1. INTRODUCTION

*Listeria monocytogenes* (LM) is an anaerobic gram-positive bacillus, widely distributed in nature, that shows predilection to infect the central nervous system (CNS) [1]. LM is a food-borne pathogen that enters the host body mainly through the intestine and is responsible for listeriosis [2].

The most common presentations of CNS listeriosis are meningitis and rhombencephalitis. Brain abscesses due to LM are extremely rare, with an incidence of approximately 10%, and are associated with a high mortality rate.

They are mostly seen in patients with immunodeficiency or diabetes. Their clinical and radiological manifestations lack specificity [3].

## 2. CASE REPORT

A 70-year-old man, with a history of rheumatoid arthritis diagnosed 7 years ago, under treatment with corticosteroids (4 mg/day) and methotrexate (10 mg/week), presented 2 days prior to his admission a left arm and leg weakness of acute onset, which progressed to hemiplegia. He had no headache, dizziness or fever prior to his admission.

Clinical examination revealed hemiplegia and muscle strength was graded as follows: right extremities: 5/5; left arm: 0/5, left leg: 3/5. There was neither sensitive impairment nor aphasia. Deep-tendon reflexes were symmetric, and there was no Babinski sign. Neither rigid neck nor Kernig's sign were present.

A brain CT scan (Fig. 1) showed an irregular isodense lesion of the central sulcus, with a gyriform aspect, along the white matter bundles. This lesion was surrounded by an equally irregular peripheral hypodensity, corresponding to vasogenic edema. Iodine contrast uptake was minimal.

The blood analysis showed no inflammatory syndrome with an absence of leukocytosis and a normal CRP.

During his hospitalization, the patient presented fever, with a deterioration of his leg weakness, and ended up with complete left hemiplegia.

An MRI was performed (Fig. 2), revealing on T1-weighted images an iso-intense T1 lesion, with peripheral hypo-intensity with a gyrus-like aspect, corresponding to the vasogenic edema. T1-T1-weighted post-contrast image shows a peripheral enhancement. The DWI sequence showed a restricted diffusion. The perfusion sequence showed no hyperperfusion. These results suggested an intracranial mass lesion possibly of infectious origin.

The patient underwent an open biopsy of the right frontal mass under general anesthesia. Intra-operatively,



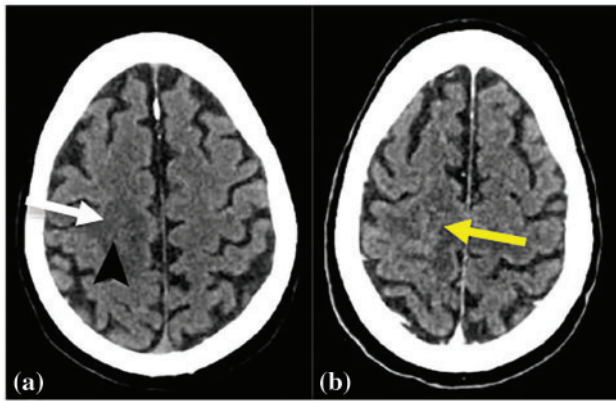


Fig. 1. Brain CT in axial view (a) pre-contrast (b) post-contrast: showing a right frontal lesion, located in the central sulcus, isodense to the parenchyma (black arrow) with peripheral hypodensity corresponding to vasogenic edema (white arrow). Post-contrast shows minimal enhancement of the lesion (yellow arrow).

no purulent collection was found, but the aspect of the parenchyma was consistent with cerebritis.

We proceeded to a biopsy and submitted the sample for bacteriological and histological testing. The bacterial culture revealed the presence of *Listeria monocytogenes*, which was sensitive to ampicillin, and meropenem. We concluded with the diagnosis of cerebral abscess due to *L. monocytogenes*.

The patient was treated with ampicillin for 4 weeks. He recovered partially from his hemiplegia and was transferred to the rehabilitation department.

Follow-up imaging was carried out 18 days later, revealing an increase in the size of the abscess, which led to the indication for surgical drainage (Fig. 3). Intraoperatively, we were able to drain 10 ml of pus under neuro-navigation.

Post-operatively, ampicillin treatment was maintained with the addition of gentamycin for 3 days. The patient developed respiratory distress following a COVID-19 infection, requiring admission to the intensive care unit (ICU).

During his stay in the ICU, the patient developed acute renal failure secondary to the nephrotoxicity of ampicillin, which required the latter to be withdrawn and replaced by meropenem.

The evolution was favourable, after 14 days of meropenem treatment with clinical and biological improvement. The follow-up imaging showed a regression in the size of the abscess (Fig. 4).

After completing his antibiotic treatment, the patient was declared cured, although he nevertheless kept his motor deficit, for which he was transferred back to the rehabilitation unit.

### 3. DISCUSSION

The *Listeria* genus is a gram-positive, non-spore-forming, non-capsulated, aero-anaerobic bacillus. It currently includes 17 species [1].

Human listeriosis is almost exclusively due to the species *Listeria monocytogenes*. It is a facultatively intracellular

bacterium, well adapted for survival as a saprophyte in soil and in decaying vegetation.

After ingestion, *Listeria* enters the bloodstream via the intestinal mucosa, which can lead to systemic disease [4]. Its pathogenicity is mainly due to its invasiveness and virulence factors that allow it to grow and survive intracellularly in a wide range of cell types.

The elimination of *Listeria* by the immune system is conditioned by the proper functioning of T-cell-activated macrophages, as well as the secretion of TNF [5].

Listeriosis can invade the CNS in 3 distinct ways: it can cross the blood–brain or blood–choroidal barrier, invade endothelial cells through extracellular blood transmission, or migrate in a retrograde fashion to the brain through nerve axons [6].

Neurolisteriosis mostly occurs in newborn, immunocompromised patients and the elderly [6]. Most patients are male [7].

After a literature review, several risk factors have been associated with a resurgence of *Listeria*. The most frequent ones are pregnancy, immunodeficiency, cancer, HIV infection, cirrhosis, diabetes mellitus, alcohol intoxication and immunosuppressive therapy [8], [9].

Listeriosis is associated with a high mortality rate of 20%–30%, which can be halved in the case of neurolisteriosis. The high morbidity is most often due to neurological sequelae [10].

It most often manifests as meningitis or meningoencephalitis, rhombencephalitis, or cerebritis, which more rarely evolves into cerebral abscess [11], [12]. After a review of the literature, we found 87 cases of brain abscess caused by *Listeria*, reported from 1968 to 2021 [13], [14].

Headache is the most common symptom reported by patients with LM brain abscess, however focal neurologic findings on examination were more frequently reported in *Listeria* abscess compared to other causes.

*Listeria* brain abscess affects more often the brain stem, followed by supratentorial white matter and cerebellar hemispheres [6]. The radiological appearance is similar to that of other brain abscesses, but with some specific patterns, as reported by Slezák *et al.* [15]: irregular formations, revealing the characteristic worm-like tubular pattern of curvilinear arrangement.

Some authors suggest that the axonal invasion is the pathological substrate of the multi-tubular appearance of the LM abscess in the imaging [16]. CSF analysis is of little interest, with a low rate of bacterial identification when cultured. *Listeria* is identified in blood cultures up to 60% of the neurolisteriosis [12], [17]–[19].

The treatment of *Listeria* brain abscess is antibiotics. The first line treatment is ampicillin combined with gentamicin [20], although several studies report that ampicillin alone is not associated with increased mortality [6]. However, a synergistic effect has been demonstrated when ampicillin is combined with gentamicin.

Meropenem has also demonstrated its effectiveness in the treatment of *Listeria* abscesses [6]. The duration of treatment is usually 2 to 4 weeks, for cases of strong suspicion or confirmation of the diagnosis. This duration is extended to 6 weeks for immunocompromised patients.

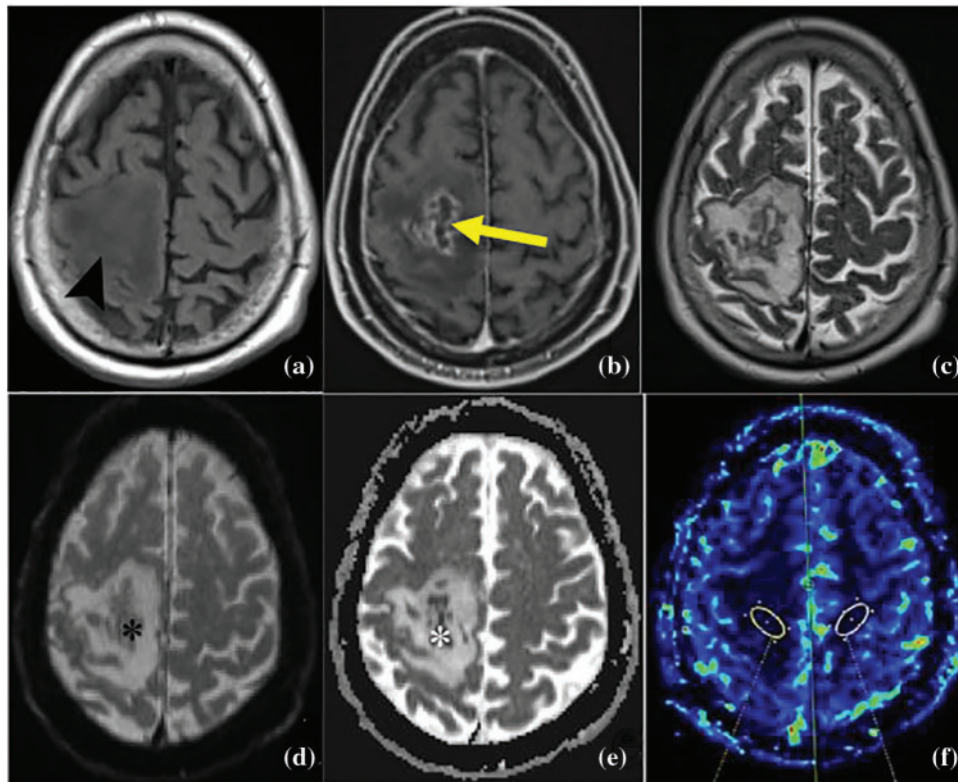


Fig. 2. MRI images demonstrating a right frontal lesion of the central sulcus: (a) in the T1-weighted image it appears as an iso-intense lesion (head arrow) with peripheral hypo-intense signal corresponding to vasogenic edema (arrowhead), (b) Post-contrast image shows a worm-like enhancement (white arrow), (c) In the T2-weighted image the lesion appears iso-intense with peripheral hyper signal around, (d) DWI shows a mild restricted diffusion (white asterisk) corresponding to a hypercellularity of the lesion confirmed by the (e) ADC sequence (black asterisk), (f) No hyperperfusion was noted (right yellow circle) in the perfusion sequence.

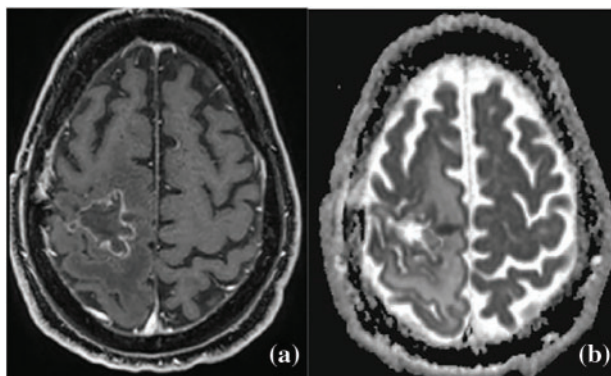


Fig. 3. MRI images demonstrating an increase in the size of the Listeria abscess (a) in the T1-weighted post-contrast image, (b) DWI shows an increase of the restriction diffusion corresponding.

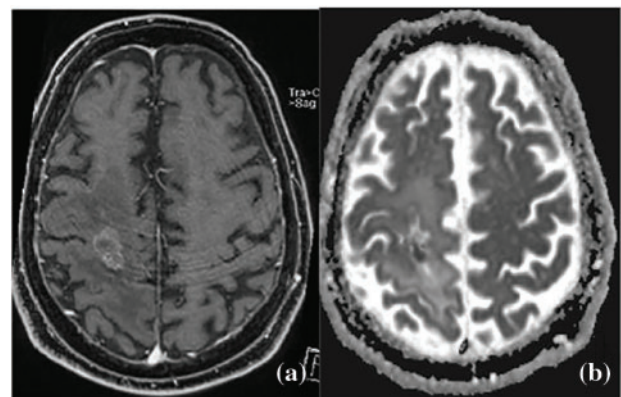


Fig. 4. MRI images demonstrating the regression in the size of the Listeria abscess (a) in the T1-weighted post-contrast image, (b) DWI shows a decrease of the restriction diffusion.

Antibiotic treatment should be extended up to 1 week after apyrexia [6].

Surgical aspiration is suggested for large abscesses with a diameter superior to 2.5 cm, abscesses located in deep brain matter, and also for identification of the bacteria for treatment guidance [21], [22].

Surgical drainage is also considered in cases of drug-resistant abscess or failure of the antibiotic treatment alone [21]. Surgical drainage either through stereotactic aspiration or craniotomy has shown a higher survival rate than medical treatment alone [7].

Brain abscesses due to listeria have a poor prognosis, with a higher mortality rate than abscesses of other causes.

This mortality is probably due to immunosuppression and other risk factors [23], [24].

The brain MRI has demonstrated its usefulness in assessing the response and efficacy of antibiotic treatment [10], [17], [18]. In our case, we confirmed the diagnosis with an open biopsy. We then opted initially for an ampicillin-based monotherapy. Following the unfavorable radiological evolution, surgical drainage was performed, with gentamycin added to the initial antibiotic treatment. The patient developed renal failure secondary to bi-antibiotic therapy, which was subsequently replaced by meropenem with a good outcome. Currently, there are no

guidelines for the diagnosis and treatment of *Listeria monocytogenes* brain abscess. Based also on previous literature, Zhang *et al.* proposed five points considering the diagnosis of *Listeria* brain abscess [6]:

1. The disease is of acute onset, most of the patients are immunosuppressed or present recent changes in their eating habits and may have a history of prodromal infection.
2. Fever is the most common first clinical manifestation and can be accompanied by headache, nausea, meningeal irritation and focal neurological dysfunction.
3. MRI shows a longer signal on T2-weighted images and hyperintense in DWI images. Rim enhancement, perifocal edema and local mass effect are the typical characteristics of brain abscesses.
4. Excluding intracranial space occupying and other bacterial brain abscesses is of cardinal importance.
5. *Listeria monocytogenes* is cultured in the blood or cerebrospinal fluid of the patient.

#### 4. CONCLUSION

*Listeria* is a rare cause of brain abscess compared with other bacteria and the prognosis is usually poor. Its clinical presentation is similar to that of other brain abscesses. On MRI, typical imaging patterns can be found, which help to suggest the diagnosis. Diagnosis can be confirmed either by blood culture or biopsy. Surgical drainage improves prognosis. Response to antibiotics, particularly ampicillin, associated with gentamycin is favorable.

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#### CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

#### REFERENCES

- [1] Murray PR, Baron EJ. *Manual of Clinical Microbiology*. 9th ed. Washington, D.C: ASM Press; 2007.
- [2] Ramaswamy V, Cresence VM, Rejitha JS, Lekshmi MU, Dharsana KS. *Listeria*—review of epidemiology and pathogenesis. *J Microbiol Immunol Infect Wei Mian Yu Gan Ran Za Zhi*. 2007;40(1):4–13.
- [3] Lorber B. Listeriosis. *Clin Infect Dis Off Publ Infect Dis Soc Am*. 1997;24(1):1–9. doi: 10.1093/clinids/24.1.1. quiz 10-11.
- [4] Radoshevich L, Cossart P. *Listeria monocytogenes*: towards a complete picture of its physiology and pathogenesis. *Nat Rev Microbiol*. 2018;16(1):32–46. doi: 10.1038/nrmicro.2017.126.
- [5] Neighbors M, Xu X, Barrat FJ, Ruuls Sigrid R, Churakova T, Debets R, *et al.* A critical role for interleukin 18 in primary and memory effector responses to *Listeria monocytogenes* that extends beyond its effects on interferon  $\gamma$  production. *J Exp Med*. 2001;194(3):343–54.
- [6] Zhang J, Huang S, Xu L, Tao M, Zhao Y, Liang Z. Brain abscess due to *Listeria monocytogenes*. *Med (Baltimore)*. 2021;100(31):e26839. doi: 10.1097/MD.00000000000026839.
- [7] Eckburg PB, Montoya JG, Vosti KL. Brain abscess due to *Listeria monocytogenes*: five cases and a review of the literature. *Med (Baltimore)*. 2001;80(4):223–35. doi: 10.1097/00005792-200107000-00001.
- [8] Charlier C, Perrodeau É, Leclercq A, Cazenave B, Pilmis B, Henry B, *et al.* Clinical features and prognostic factors of listeriosis: the MONALISA national prospective cohort study. *Lancet Infect Dis*. 2017;17(5):510–9. doi: 10.1016/S1473-3099(16)30521-7.
- [9] de Noordhout CM, Devleeschauwer B, Angulo FJ, Verbeke G, Haagsma J, Kirk M, *et al.* The global burden of listeriosis: a systematic review and meta-analysis. *Lancet Infect Dis*. 2014;14(11):1073–82. doi: 10.1016/S1473-3099(14)70870-9.
- [10] Silva C, Ferrão D, Almeida M, Nogueira-Silva L, Almeida JS. Neuroinfection: the importance of a prompt diagnosis. *Cureus*. 2021;13(7):e16662. doi: 10.7759/cureus.16662.
- [11] Bazooyar B. Rhombencephalitis by *Listeria monocytogenes* in two diabetic patients. *Arch Iran Med*. 2015;18(9):613–5.
- [12] Kayaaslan BU, Akinci E, Bilen S, Gözel MG, Erdem D, Cevik MA, *et al.* Listerial rhombencephalitis in an immunocompetent young adult. *Int J Infect Dis IJID Off Publ Int Soc Infect Dis*. 2009;13(2):e65–7. doi: 10.1016/j.ijid.2008.06.026.
- [13] Chung J, McCarthy KL, Redmond A, Butler J, Scott AP, Stewart AG. *Listeria monocytogenes* brain abscess as a late complication of allogeneic haemopoietic stem cell transplantation. *Intern Med J*. 2021;51(6):1005–6. doi: 10.1111/imj.15356.
- [14] Tiri B, Priante G, Saraca LM, Martella LA, Cappanera S, Francisci D. *Listeria monocytogenes* brain Abscess: controversial issues for the treatment—two cases and literature review. *Case Rep Infect Dis*. 2018;2018:6549496. doi: 10.1155/2018/6549496.
- [15] Slezák O, Žižka J, Kvasnička T, Dvořáková R, Česák T, Ryšková L, *et al.* Worm-like appearance of *Listeria monocytogenes* brain abscess: presentation of three cases. *Neuroradiol*. 2020;62(9):1189–93. doi: 10.1007/s00234-020-02441-9.
- [16] Peh WM, Hean GG, Clement YHR. The tunnel sign revisited: a novel observation of cerebral melioidosis mimicking sparganosis. *J Radiol Case Rep*. 2018;12(8):1–11. doi: 10.3941/jrcr.v12i8.3441.
- [17] Van de Beek D, de Gans J, Spanjaard L, Weisfelt M, Reitsma JB, Vermeulen M. Clinical features and prognostic factors in adults with bacterial meningitis. *N Engl J Med*. 2004;351(18):1849–59. doi: 10.1056/NEJMoa040845.
- [18] Czupryna P, Zajkowska A, Garkowski A, Pancewicz S, Moniuszko A, Guziejko K, *et al.* Listerial rhombencephalitis in an immunocompetent woman. *Case Rep Neurol Med*. 2014;2014:674321. doi: 10.1155/2014/674321.
- [19] Beynon C, Neumann JO, Bösel J, Unterberg AW, Kiening KL. Stereotactic biopsy and drainage of a brainstem abscess caused by *Listeria monocytogenes*. *Neurol Med Chir (Tokyo)*. 2013;53(4):263–5. doi: 10.2176/nmc.53.263.
- [20] Leclercq R, Cantón R, Brown DFJ, Giske CG, Heisig P, MacGowan AP, *et al.* EUCAST expert rules in antimicrobial susceptibility testing. *Clin Microbiol Infect Off Publ Eur Soc Clin Microbiol Infect Dis*. 2013;19(2):141–60. doi: 10.1111/j.1469-0691.2011.03703.x.
- [21] Mathisen G, Johnson J, Mathisen GE, Johnson JP. Brain abscess. *Clin Infect Dis*. 1997;25:763–81. Clin Infect Dis 25. Published online 1997:763-781.
- [22] Sonnevile R, Ruimy R, Benzonana N, Riffaud L, Carsin A, Tadié J-M, *et al.* An update on bacterial brain abscess in immunocompetent patients. *Clin Microbiol Infect Off Publ Eur Soc Clin Microbiol Infect Dis*. 2017;23(9):614–20. doi: 10.1016/j.cmi.2017.05.004.
- [23] Moragas M, Martínez-Yélamos S, Murillo O, Fernández-Viladrich P. Brain abscess due to *Listeria monocytogenes* in adults: six cases and review of the literature. *Enferm Infecc Microbiol Clin*. 2010;28(2):87–94. doi: 10.1016/j.eimc.2009.01.011.
- [24] Cone LA, Leung MM, Byrd RG, Annunziata GM, Lam RY, Herman BK. Multiple cerebral abscesses because of *Listeria monocytogenes*: three case reports and a literature review of supratentorial listerial brain abscess(es). *Surg Neurol*. 2003;59(4):320–8. doi: 10.1016/s0090-3019(03)00056-9.