

# Bone and Vertebral Infections by *Listeria monocytogenes*

Subjects: **Infectious Diseases**

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*Listeria monocytogenes* is a Gram-positive pathogenic bacterium which can be found in soil or water. Infection with the microorganism can occur after ingestion of contaminated food products. Small and large outbreaks of listeriosis have been described in the past. *L. monocytogenes* can cause a number of different clinical syndromes, most frequently sepsis, meningitis, and rhombencephalitis, particularly in immunocompromised hosts. *L. monocytogenes* systemic infections can develop following tissue penetration across the gastrointestinal tract or to hematogenous spread to sterile sites, possibly evolving towards bacteremia. *L. monocytogenes* only rarely causes bone or joint infections, usually in the context of prosthetic material that can provide a site for bacterial seeding.

*L. monocytogenes*

imaging

microbiological diagnosis

surgical approach

antibiotic treatment

infections

## 1. Introduction

*Listeria monocytogenes* is a Gram-positive, motile, facultative, anaerobe bacteria that inhabits a broad ecologic niche <sup>[1][2]</sup>. The microorganism can be isolated from soil, water, and vegetation, including raw vegetables intended for human consumption without further processing <sup>[3][4]</sup>. Newer chromogenic media may offer advantages in the detection of contaminated food <sup>[5][6]</sup>. The surface contamination of meat and vegetables is common, with up to 15% of these foods harboring the microorganism. Furthermore, *L. monocytogenes* is a transient inhabitant of both animal and human gastrointestinal tracts; intermittent carriage suggests possible frequent exposure <sup>[7][8]</sup>. Usually, the gut is the source for microorganisms in case of invasive listeriosis; the virulence factor ActA is associated with carriage development <sup>[9]</sup>. The microorganism has a competitive advantage against other Gram-positive and Gram-negative bacteria in cold environments, such as refrigerators; it is also amplified in spoiled food products, possibly leading to increased alkalinity. Feeding of spoiled silage with a high pH has resulted in epidemics of listeriosis in sheep and cattle <sup>[10]</sup>. Several foodborne outbreaks of listeriosis have been the result of animal epidemics; the first one occurred in Canada and was associated with the ingestion of contaminated coleslaw <sup>[11]</sup>. Subsequently, many other foodstuffs have been implicated in different outbreaks, including cheeses made with raw or pasteurized milk or milk derivatives <sup>[12][13][14][15][16][17][18][19][20][21][22][23]</sup>, meat products <sup>[24][25][26][27][28][29]</sup>, and fruits and vegetables <sup>[30][31][32][33][34]</sup>. **Table 1** summarizes the food products that are usually implicated in the occurrence of foodborne listeriosis. In addition, hospitalized individuals also seem to be at risk of acquiring *L. monocytogenes* infections <sup>[35]</sup>. To optimize the tracking of listeriosis cases, whole-genome sequencing has been developed; this has replaced

older techniques, such as serotyping [36][37]. However, the question of why outbreaks of listeriosis can occur in humans remains incompletely understood; a possible enhancement of organism-specific virulence factors may play a role in developing epidemic dissemination.

**Table 1.** Foods that are usually implicated in foodborne listeriosis.

Dairy Products	Fruits and Vegetables	Meat Products	Fish Products
Pasteurized whole milk	Coleslaw (cabbage)	Delicatessen foods (deli meats)	
Chocolate milk	Lettuce	Pâté	
Soft cheese (different types)	Corn	Foie gras	
Hard cheese	Rice salad	Uncooked hot dogs	Shrimp salad
Mexican-style cheese	Salted mushrooms	“Rillettes”	Tuna salad
Goat cheese	Sprouts	Pork tongue in aspic	Smoked fish
Ice cream	Strawberries	Pork pie	
Fresh cream	Nectarines	Beef	
	Apples	Turkey franks	
	Cantaloupes	Jellied pork	
	Blueberries	Cooked ham	
	Stone fruit	Ox tongue	
		Undercooked chicken	

*L. monocytogenes* only rarely causes bone and joint infections; this usually occurs in the context of prosthetic material that can provide a site for bacterial seeding.

1. Welshimer, H.J.; Donker-Voet, J. *Listeria monocytogenes* in nature. *Appl. Microbiol.* 1971, 21, 510–519.

2. Imaging Techniques

2. Linke, K.; Ruckerl, I.; Brugger, K.; Karpiskova, R.; Walland, J.; Muri-Klinger, S.; Tichy, A.; Wagner, M.; Stessl, B. Reservoirs of *Listeria* species in three environmental ecosystems. *Appl. Environ. Micro.* 2014, 80, 5583–5592.

could provide valuable information in terms of bone erosions and vertebral bone integrity, mainly in the later stages of the disease; during the early stage of infection, no significant finding is usually detected. Furthermore, spinal stability must be assessed among patients in whom surgical management is being considered. Indeed, vertebral collapse, kyphotic deformity, and loss of normal lordosis can be found in advanced infections. CT also provides

3. Law, J.W.; Mitalib, N.S.; Chan, K.G.; Lee, J.H. An insight into the isolation, enumeration, and molecular detection of *Listeria monocytogenes* in food. *Front. Microbiol.* 2015, 6, 1227–1242.

4. Graves, L.M.; Swaminathan, B.; Ajello, G.W.; Malcom, G.D.; Weaver, R.E.; Ransom, R.; Dever, K.; Pikaytis, B.D.; Schuchat, A.; Wenger, J.D.; et al. Comparison of three selective enrichment methods for the isolation of *Listeria monocytogenes* from naturally contaminated foods. *J. Food Prot.* 1992, 55, 952–959.

5. Bres, V.; Yang, H.; Hsu, E.; Ren, Y.; Cheng, Y.; Wisniewski, M.; Hanhan, M.; Zaslavsky, P.; Noll, N.; Weaver, B.; et al. *Listeria monocytogenes* LmG2 detection assay using transcription mediated amplification to detect *Listeria monocytogenes* in selected foods and stainless steel surfaces. *J. AOAC Int.* 2014, 97, 1343–1358.

diagnostic (e.g., due to the presence of metallic implants causing artifacts), other imaging modalities should be considered. CT myelography provides another way of visualizing the spinal cord and ruling out compression in the

6. Reisch, R. New detection media for detection and enumeration of pathogens in food. *Food Microbiol.* 2004; 19: 1-9. *offer a high degree of sensitivity.* In the early stages of infection, spinal infections can occasionally be multifocal, so the whole spine should be scanned if an infectious focus is detected.

7. Grif, K.; Hein, I.; Wagner, M.; Brandl, E.; Mpmugo, O.; McLauchlin, J.; Dierich, M.P.; Allerberger, F. Prevalence and characterization of *Listeria monocytogenes* in the feces of healthy Austrians.

### 3. Microbiological Diagnosis

8. Gahan, C.G.; Hill, C. *Listeria monocytogenes*: Survival and adaptation in the gastrointestinal tract. The determination of a microbiological diagnosis of *E. monocytogenes* bone or vertebral infection is challenging, especially in the absence of referred exposures or negative blood tests. In this context, aspiration biopsy or

9. Travier, L.; Guadagnini, S.; Gouin, E.; Dufour, A.; Chénal-Prades, V.; Cossart, P.; Olive-Marie, E.; C. Chigic, J.M.; Disson, O.; Lecat, M. *Acta* promotes *Listeria monocytogenes* aggregation, in order to obtain valid samples for cultures postoperative and microbiological administration can improve the intestinal colonization and carriage. *PLoS Pathog.* 2013; 9: e1003131.

10. Low, J.C.; Renton, C.P. Septicaemia, encephalitis and abortions in a housed flock of sheep involvement [38]. However, the initiation of an antibiotic treatment does not always preclude undertaking a biopsy [39]; in those cases where antibiotic treatment has already been started, it has been demonstrated that interrupting

11. Schlecht, W. Antibiotic resistance, Bortolussi, R. A.; Altemper, C.; Blauding, F. V.; Wotzky, J. Pre-biopsy [40]. The

12. Bula, C.J.; Bille, J.; Glauser, M.P. An epidemic of food-borne listeriosis in western Switzerland: therapeutic issues should be taken into consideration when managing *L. monocytogenes* vertebral infections. Description of 57 cases involving adults. *Clin. Infect. Dis.* 1995; 20: 66–72.

13. Centers for Disease Control and Prevention (CDC). Outbreak of listeriosis associated with homemade Mexican-style cheese: North Carolina, October 2000–January 2001. *MMWR Morb. Mortal. Wkly. Rep.* 2001; 50: 560–562.

In the absence of neurological deficits or sepsis, the optimal therapeutic approach comprises medical management with adequate intravenous antibiotics and immobilization of the affected spinal segment. Antibiotic therapy should be started as soon as the microorganism has been isolated in order to achieve sterilization of the infected bone or vertebral disc and prevent the occurrence of a neurological deficit or painful deformity. The duration of antibiotic therapy varies depending on the extent of bone involvement and the status of the patient's immune system.

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Neurosurgical intervention should be considered only after taking into account a given patient's neurological status as well as the extent of bone erosion and the specific vertebral level involved. The principles of surgical treatment include debridement of infected tissue, decompression of neural elements, and the restoration of spinal alignment and/or correction of spinal instability. The presence of neurological deficits is considered to be the most important

15. Carrigue-Mas, J.J.; Hökeberg, I.; Andersson, Y.; Arneborn, M.; Tham, W.; Danielsson-Tham, M.L.; Osterman, B.; Leffler, M.; Steen, M.; Eriksson, E.; et al. Febrile gastroenteritis after eating on-farm manufactured fresh cheese: An outbreak of listeriosis? *Epidemiol. Infect.* 2003; 130: 79–86.

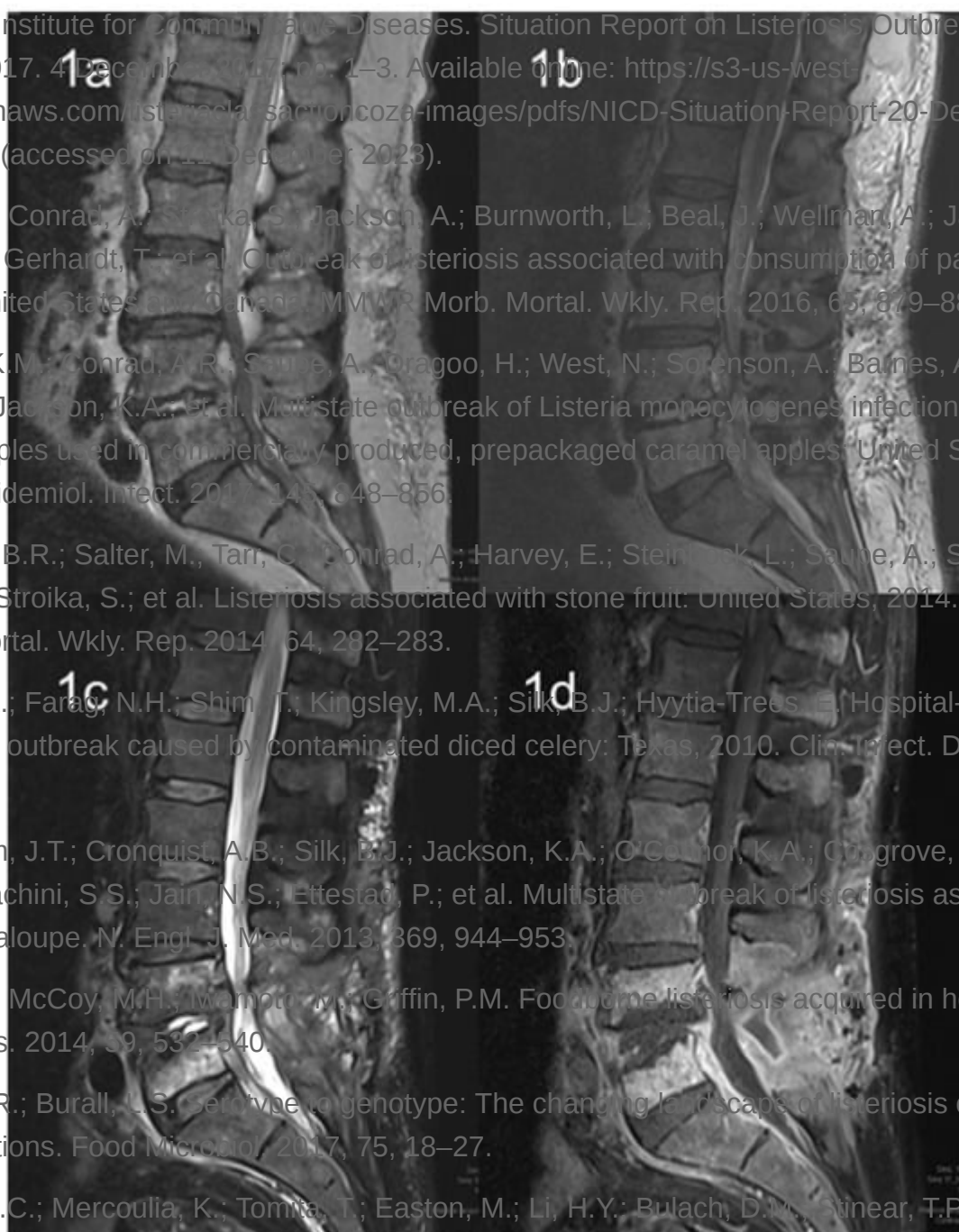
16. Liorio-Huie, M.; Masco, J.; Jones, X.D.; Goulet, V.; May, S.; Salmeron, C.; Hark, D.; Venkayya, M.; Hayes, P.; Weavers, R.; et al. Epidemic listeriosis associated with Mexican-style cheese. *Engl. J. Med.* 1988; 319: 823–828.

17. Chor, M.J.; Jackson, K.A.; Medus, C.; Beal, J.; Rigdon, C.E.; Cloyd, T.C.; Forstner, M.J.; Ball, J.; Bosch, S.; Bottichio, L.; et al. Multistate outbreak of listeriosis linked to soft-ripened cheese: relevant; the liquid collection of pus can be drained, whereas a mass of granulation tissue or retro pulsed bone are better addressed with an open surgical approach. In addition, the optimal surgical approach is selected after consideration of the intrinsic features of each anatomic region of the spine and the likelihood of postoperative

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29. National Institute for Communicable Diseases. Situation Report on Listeriosis Outbreak, South Africa, 2017. 4 December 2017; pp. 1–3. Available online: <https://s3-us-west-2.amazonaws.com/listeria-outbreak-coza-images/pdfs/NICD-Situation-Report-20-December-2017.pdf> (accessed on 11 December 2023).
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31. Angelo, K.M.; Conrad, A.R.; Saube, A.; Dragoo, H.; West, N.; Sorenson, A.; Barnes, A.; Doyle, M.; Beal, J.; Jackson, K.A.; et al. Multistate outbreak of *Listeria monocytogenes* infections linked to whole apples used in commercially produced, prepackaged caramel apples: United States, 2014–2015. *Epidemiol. Infect.* 2017, **145**, 848–856.
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**Figure 1.** Evolution of MRI in a patient with epidural abscess by *L. monocytogenes*. (1a) T2 weighted image at base of L4; (1b) T1 weighted image at L4; (1c) T2 weighted image at L4; (1d) T1 weighted image at L4.

**Table 2.** Characteristics of patients with *Listeria monocytogenes* vertebral osteomyelitis.

Author	Age	Gender	Co-Morbidities	Clinical Symptoms	Duration of Symptoms	Antibiotic Treatment and Duration	Surgery	Ref.
Adebolu et al. [47]	60	M	Polymyalgia rheumatica	Back pain	12 months	Ampicillin, IV, 6 weeks Gentamicin, IV, 2 weeks	Yes	10
J.N.; Cockerill, F.R.; Steckelberg, J.M.; Greenleaf, J.F.; et al.								11

	Author	Age	Gender	Co-Morbidities	Clinical Symptoms	Duration of Symptoms	Antibiotic Treatment and Duration	Surgery
48	Khan et al. [48]	69	M	Prior spinal laminectomy	Back pain	5 months	Ampicillin, IV * Gentamicin, IV *	Yes
49	Camp et al. [49]	67	M	DM, prior lumbar surgery	Back pain	Unknown	Oxacillin, IV * Streptomycin, IV *	Yes
50	Chirgwin et al. [50]	57	M	DM, asthma	Fever, back pain	3 weeks	Ampicillin, IV, 6 weeks Tobramycin, IV, 6 weeks	Yes
51	Aubin et al. [51]	92	M	DM, heart failure, hip arthroplasty	Fever	1 week	Amoxicillin, IV, 6 days Gentamicin, IV, 4 days Trimethoprim-sulfamethoxazole, oral, 12 weeks	Yes
52	Hasan et al. [52]	63	M	DM, aortic valve replacement	Fever, back pain	2 days	Benzyl penicillin, IV, 6 weeks Rifampicin, oral, 4 weeks Amoxicillin, oral, 18 weeks	Yes
53	Duarte et al. [53]	65	M	DM	Fever	5 days	Ampicillin, IV, 2 weeks Amoxicillin, oral, 12 weeks	Yes
54	Al Ohaly et al. [54]	79	M	Hypertension, carotid bypass, repair of AAA	Back pain	3 weeks	Ampicillin, IV, 6 weeks	No

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49. Camp, C.; Luft, W.C. *Listeria monocytogenes* osteomyelitis. *Guthrie Bull.* 1973, 43, 32–38.
50. Chirgwin, K.; Gleich, S. *Listeria monocytogenes* osteomyelitis. *Arch. Intern. Med.* 1989, 149, 931–932.
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