Unusual infections due to *Listeria monocytogenes* in the Southern California Desert


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Introduction

In non-pregnant women and in older children and adolescents, listeriosis is usually secondary to impaired cell-mediated immunity, which is either congenital, acquired, iatrogenically-induced, or associated with metabolic disorders.1–4 Nevertheless, as many as 30% of adults and 54% of children infected by *Listeria monocytogenes* have no predisposing medical disorder.5,6 Recent food outbreaks of listeriosis indicate that the organism can cause gastrointestinal as well as systemic infection in healthy people. In the USA, human infection presents with bacteremia or meningitis in over 75% of those individuals with listeriosis.4
Unusual infections due to *Listeria monocytogenes*

The Coachella Valley of Southern California is a desert community of more than 300,000 inhabitants and is a major retirement and tourist sight for its eight adjacent communities. Eisenhower Medical Center (EMC), a 300-bed hospital, provides medical services to a large segment of this population. It also provides subspecialty consultation to other hospitals extending to the border with Mexico and Arizona, as well as north to Nevada.

Geographically the Coachella Valley is a 1500 square mile region in the heart of the Colorado Desert. It averages 4 inches of rain annually and outdoor temperatures can reach 125°F (52°C) with low humidity in the summer months. There is little animal husbandry in the area and agriculture is confined to land surrounding the Colorado River. Recreational facilities abound in and around the cities of the Coachella Valley including more than 110 golf courses, tennis courts, as well as tens of thousands of swimming pools.

During the past 22 years listerial infection has been diagnosed in 14 patients at EMC. In contrast to national statistics, only five of 14 (36%) individuals presented with bacteremia or meningitis. We therefore undertook a detailed study to evaluate clinical presentations and predisposing disorders in patients with listeriosis residing in the Coachella Valley.

**Materials and methods**

A case of listeriosis was defined as infection due to *L. monocytogenes* when isolated from a normally sterile site such as blood, cerebrospinal fluid (CSF), or a joint. Infection involving a mother and her child was considered a single infection. Isolates of *L. monocytogenes* were defined as: (1) Gram-positive organisms, (2) Voges–Proskauer positive, (3) urease negative, (4) catalase positive, (5) oxidase negative, and (6) hemolytic on horse blood. The 14 patients with listeriosis ranged in age between newborn and 93 years.

**Results**

Four patients presented with arterial wall infections, three with abdominal aortic aneurysms, and one had an infected femoropopliteal graft. This latter patient had underlying rheumatoid arthritis and was receiving prednisone and azathioprine, while one of the infected aortic aneurysms had diabetes, another had a history of non-Hodgkin lymphoma but was free of recurrence, and one had no complicating medical disorders. They ranged in age from 59 to 85 years. Two of the four died within 30 days of surgery, one from sepsis and the other from a ruptured aortic aneurysm.

Three patients were diagnosed with multiple cerebral abscesses and ranged in age from 47 to 70 years. One was diagnosed with HIV but had never experienced an opportunistic infection, one consumed excessive quantities of alcohol but was otherwise healthy, and a third had systemic lupus erythematosus with chronic hepatitis and was receiving prednisone. The patient with HIV and the one with alcoholism died, the former from concomitant cytomegalovirus encephalitis and *Mycobacterium avium-intracellulare* bacteremia, both of which were untreated, and the latter from progressive central nervous system (CNS) disease. The third survived and the abscesses resolved by magnetic resonance imaging (MRI).

Two patients, both with rheumatoid arthritis and receiving corticosteroids, one of whom was receiving etanercept intermittently, developed listerial septic arthritis of a previous hip replacement. One was 81 and the other 71 years old. One of these patients had a history of arteriosclerotic heart disease and congestive heart failure and died from pulmonary edema, the other survived and was cured of the infection with appropriate antimicrobial therapy.

Four patients presented with bacteremia. Their ages ranged from 32 to 93 years. Two patients were pregnant and in one the baby boy had *L. monocytogenes* isolated from his blood at delivery as well. One patient had hairy cell

### Table 1  *Listeria monocytogenes* infections in 14 patients

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Disease site</th>
<th>Age/sex</th>
<th>Associated disease</th>
<th>Area involved</th>
<th>Isolation site</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aneurysm</td>
<td>74/F</td>
<td>Diabetes</td>
<td>Abdominal aorta</td>
<td>Aneurysm</td>
<td>Died</td>
</tr>
<tr>
<td>2</td>
<td>Fem-pop graft</td>
<td>59/M</td>
<td>Rheumatoid arthritis</td>
<td>By-pass</td>
<td>Blood</td>
<td>Survived</td>
</tr>
<tr>
<td>3</td>
<td>Aneurysm</td>
<td>70/M</td>
<td>None</td>
<td>Abdominal aorta</td>
<td>Aneurysm</td>
<td>Survived</td>
</tr>
<tr>
<td>4</td>
<td>Cerebral abscess</td>
<td>85/M</td>
<td>History of lymphoma</td>
<td>Abdominal aorta</td>
<td>Blood</td>
<td>Died</td>
</tr>
<tr>
<td>5</td>
<td>Cerebral abscess</td>
<td>47/M</td>
<td>HIV+</td>
<td>Frontal abscess</td>
<td>Brain, blood</td>
<td>Died</td>
</tr>
<tr>
<td>6</td>
<td>Cerebral abscess</td>
<td>56/F</td>
<td>Lupus erythematosus</td>
<td>Frontal, occipital abscesses</td>
<td>Brain, blood</td>
<td>Survived</td>
</tr>
<tr>
<td>7</td>
<td>Cerebral abscess</td>
<td>70/M</td>
<td>Alcoholism</td>
<td>Multiple cerebral abscesses</td>
<td>CSF, blood</td>
<td>Died</td>
</tr>
<tr>
<td>8</td>
<td>Prosthetic hip</td>
<td>81/F</td>
<td>Rheumatoid arthritis, hip replacement</td>
<td>Hip joint</td>
<td>Hip</td>
<td>Survived</td>
</tr>
<tr>
<td>9</td>
<td>Prosthetic hip</td>
<td>71/F</td>
<td>Rheumatoid arthritis, hip replacement</td>
<td>Hip joint</td>
<td>Hip</td>
<td>Survived</td>
</tr>
<tr>
<td>10</td>
<td>Bacteremia</td>
<td>35/F</td>
<td>Pregnancy</td>
<td>Blood</td>
<td>Blood</td>
<td>Survived</td>
</tr>
<tr>
<td>11</td>
<td>Bacteremia</td>
<td>32/F</td>
<td>Pregnancy</td>
<td>Blood</td>
<td>Blood</td>
<td>Survived</td>
</tr>
<tr>
<td>12</td>
<td>Bacteremia</td>
<td>93/M</td>
<td>Hairy cell leukemia</td>
<td>Blood</td>
<td>Blood</td>
<td>Survived</td>
</tr>
<tr>
<td>13</td>
<td>Bacteremia</td>
<td>80/F</td>
<td>Multiple myeloma</td>
<td>Blood</td>
<td>Blood</td>
<td>Survived</td>
</tr>
<tr>
<td>14</td>
<td>Meningitis</td>
<td>41/F</td>
<td>None</td>
<td>CSF, blood</td>
<td>CSF, blood</td>
<td>Survived</td>
</tr>
</tbody>
</table>

Fem-pop, femoropopliteal; HIV+, infected by human immunodeficiency virus; CSF, cerebrospinal fluid.
leukemia and was receiving chemotherapy, and one was diagnosed with multiple myeloma and was not currently receiving chemotherapy. All patients survived.

Finally a single 41-year-old woman developed meningitis due to L. monocytogenes and survived. She had no underlying disease. These data are summarized in Table 1.

Discussion

In 1919, Hulphers assigned the name Bacillus hepatis to an organism he isolated from necrotic foci in the liver of a rabbit. In 1926, Murray et al. isolated Gram-positive bacilli from rabbits in their laboratory in Cambridge, UK that were dying of wasting and manifested ascites, hepatic necrosis, and a monocytosis. They named the organism Bacterium monocytogenes. The following year, an epizootic among rodents was discovered in the Tiger River region of South Africa, and was called the Tiger River bacillus, subsequently named by Pirie, Listeria hepatolytica to honor Lord Joseph Lister, the father of antisepsis. In 1929, Nyfeldt isolated a similar organism in a human with infectious mononucleosis and also noted its similarity to the organism found by Murray et al. in the rabbit and the Tiger River bacillus. He named it Bacterium monocytogenes hominis (n.sp). In 1940 the organism was renamed Listeria monocytogenes.

Listeria monocytogenes is one of seven species of Listeria and the most commonly isolated organism in the genus. However, not all strains of L. monocytogenes are equally capable of causing disease in humans. Indeed, isolates of four (1/2a, 1/2b, 1/2c, and 4b) of the 13 serotypes (serovars) are responsible for 98% of reported human listeriosis cases. Serovar 4b occurs more often in the pregnancy-associated cases than in previously healthy non-pregnant cases and more often in the latter than in individuals with underlying disease. Certain microbial genes are associated with each serovar and establish differences in surface proteins and proteins for sugar metabolism, which probably confer traits that provide selective advantages in the environment and infected patients.

In addition to differences in the pathogenicity of the various serovars of L. monocytogenes, host immunity and associated illnesses undoubtedly predispose to listeriosis. As early as 1967, Louria et al. identified 18 patients with listerial infection and malignant disease. In 1973, L. monocytogenes was identified as a leading cause of meningitis in cancer patients.

Since L. monocytogenes is an intracellular pathogen, cell-mediated immunity plays a major role in acquiring resistance, which can be compromised both by certain neoplasms and cancer chemotherapy. Indeed, in a review of listeriosis and cancer at the MD Anderson Cancer Center, seven of 11 cases were in patients with leukemia, lymphoma, and Kaposi’s sarcoma (in an AIDS patient). Of 12 cases of listeriosis reported from the Johns Hopkins Oncology Center, nine were in patients with leukemia or lymphoma.

In our experience at EMC, listeriosis was diagnosed in three patients with cancer. One had hairy cell leukemia, another multiple myeloma, and the third had a history of non-Hodgkin lymphoma but had no evidence for lymphoma at autopsy. All manifested bacteremia and the last was also diagnosed with a listerial infection of an abdominal aortic aneurysm that resulted in his death. The other two patients survived with antimicrobial therapy with ampicillin and gentamicin. Only one previously reported patient with hairy cell leukemia and listeriosis has been found in the literature. He also responded favorably to ampicillin and gentamicin.

We have treated a total of four patients with arterial infections due to L. monocytogenes. We reviewed the world literature in 1992 and discovered seven other cases of listerial mycotic aneurysms or infected grafts. All had either arteriosclerotic vascular disease or hypertension. One had a history of non-Hodgkin lymphoma that had been completely eradicated years prior to diagnosis of the infected aneurysm. Four of these 11 patients died.

Infected arterial aneurysms are usually caused by Salmonella, followed by Staphylococcus aureus, Proteus, Klebsiella, Enterobacter, Campylobacter, Pseudomonas, pneumococci, streptococci, and gonococci.

Three patients presented with multiple brain abscesses, and in contrast to patients with listerial meningitis where immunosuppression does not predispose to disease incidence or mortality, all were immunologically impaired. Underlying diseases included chronic ethanolism, HIV infection, and systemic lupus erythematos treated with corticosteroids. Only the last patient survived. Thirty-seven other cases with listerial brain abscess were found in the literature in a recent review; mortality was about 30% and only five of 40 (12%) patients were not immunocompromised.

Finally, we have treated two patients with L. monocytogenes infection of prosthetic hip replacements for arthritic disease due to rheumatoid arthritis. Both patients were receiving corticosteroids and one was also given intermittent etanercept. The latter patient later died as a result of congestive heart failure, but both were clinically cured with ampicillin therapy. A recent review of 29 cases of listerial septic arthritis reported that large joints (hip or knee) are typically involved and the majority of patients suffer from underlying disease including rheumatoid arthritis, diabetes, and cancer or have undergone organ transplantation. Twenty-three of 26 patients in which it was reported had prosthetic joints.

Thus, the increase in immunosuppressive disorders and treatment as well as aging appear to have led to an increase in L. monocytogenes infections of arterial aneurysms, brain abscesses, and infected prostheses. Further expansion of listerial infections can be anticipated.

Conflict of interest: No conflict of interest to declare.

References