Rash, Radiculopathy, and Cognitive Biases

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BACKGROUND: Physicians rely on intuition and pattern recognition to rapidly evaluate and treat patients. While the realities of our medical system require liberal use of these heuristics to efficiently make clinical decisions, such thinking patterns are error-prone—leaving the clinician at the whims of their cognitive biases.

CASE REPORT: We describe a case of Lyme disease in which a pilot's rash and radicular pain were misdiagnosed on two separate occasions until, nearly a month after initially seeking medical care, the pilot was appropriately diagnosed and treated.

DISCUSSION: This case highlights Lyme disease's mimicry of other common diseases and underscores the need to use slower, more deliberate evaluation in conjunction with pattern recognition and intuition to provide optimal care to flyers.

KEYWORDS: erythema migrans, Lyme disease, *Borrelia,* cognitive bias, dual-process theory.

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Dual process theory posits that human thought arises from two different systems: (System 1) a quick, efficient, intuitive, but somewhat inaccurate system; and (System 2) a slower, energy-intensive, but more accurate analytical system.[5] Given the high patient volume, documentation burden, and time constraints placed on providers, they often rely heavily on System 1, using pattern recognition of disease states rather than systematic evaluation of a differential diagnosis to rapidly process complex information and make clinical decisions in an efficient manner. While the realities of modern medicine mandate a physician make frequent use of System 1, an overreliance on it and failure to activate System 2 contribute significantly to misdiagnosis.

Conservative estimates suggest diagnostic error occurs in 10–15% of clinical interactions.[3,9] Overuse of System 1 places the healthcare provider at the whims of cognitive biases—errant patterns of thinking which result in inaccurate conclusions—which play a role in around 75% of diagnostic errors.[8,10] Below, we relate a case in which several well-described cognitive biases played a role in the missed and delayed diagnosis of Lyme disease.

CASE REPORT

A 33-yr-old male, active-duty military member presented to our flight medicine clinic in Alabama complaining of 6 d of radicular pain in the L4–L5 dermatomes, extending from buttocks to toes without any break in its distribution. Hip flexion exacerbated the pain and he could not identify any alleviating factors. He denied any headache, fatigue, joint pain, fevers, or dyspnea.

On exam, vitals were within normal limits. The patient was alert and oriented, but in obvious pain. Full neurological exam was within normal limits and ocular, abdominal, respiratory, and cardiac exams also revealed no abnormal findings. On musculoskeletal exam, he was noted to have tenderness to palpation of his left thigh. Extension of the knee and flexion of the hip also elicited pain in the left thigh. Sensation was intact throughout his bilateral lower extremities. Upon examination of the skin, he was noted to have a 10 cm in diameter, faint, circular, erythematous, nonraised rash without central clearing.

The patient had presented 26 d prior to another flight medicine clinic complaining of left thigh tenderness and the erythematous, circular rash without central clearing. He was diagnosed by a residency-trained flight surgeon

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with a cellulitis and started on 10 d of Cephalexin (500 mg by mouth four times a day). His rash improved somewhat over the next few days, and he went on a scheduled mountain-climbing trip during which he developed the severe radicular pain in the L4–L5 dermatomes of his left leg as well as numbness in the first three digits of his left foot. At follow-up for his presumed cellulitis with the same flight surgeon who initially diagnosed him, his left leg pain and paresthesia were attributed to Piriformis syndrome caused by his recent climbing. He was prescribed cyclobenzaprine, ibuprofen, and hydrocodone/acetaminophen for breakthrough pain.

The patient came to us 2 d after being treated for Piriformis syndrome reporting that the medications prescribed for Piriformis syndrome provided no relief. At this visit, given his occupation as a military aviator, a travel history was elicited; it revealed travel to Pennsylvania 1 wk prior to the initial development of his rash. Rash and radicular pain in the setting of travel to a Lyme-endemic area created suspicion of Lyme disease. We empirically started him on doxycycline 100 mg twice a day for 2 wk and Lyme titers (*Borrelia burgdorferi* Ab IgG+IgM) were drawn.

Lyme titers returned positive and were confirmed by Western blot testing. On follow up, 10 d later, he reported his pain had resolved but he continued to have mild paresthesia in the first three digits of his left foot. He continued to deny any systemic symptoms, including headache, arthralgias, and fatigue. His doxycycline was extended another 2 wk for a total of 4 wk. At completion of his 4 wk of doxycycline, he reported his paresthesia had resolved, and he complained of no residual symptoms at his follow-up flight physical several months later.

DISCUSSION

Lyme disease, caused by various species of *Borrelia* via the *Ixodes* tick, is the most common tick-borne disease in the United States, with approximately 300,000 cases occurring each year, the vast majority of which occur in the Northeast.[7] Lyme disease presents in three broad stages: early, disseminated, and late. Symptoms of each stage often overlap and patients frequently will present with disseminated or late disease without ever experiencing symptoms consistent with early Lyme disease.

The most common manifestation of early Lyme is erythema migrans, which occurs within 3–30 d of tick bite.[12] Often, it is accompanied by nonspecific symptoms that resemble a viral infection. Only about 40% of erythema migrans presents as the classic target lesion; instead, most lesions present as homogeneous erythema.[11] Because of its homogeneous appearance, erythema migrans is often misdiagnosed as cellulitis, as occurred in our case.

Dissemination of the disease (within days to months) marks the second stage of Lyme. Symptoms vary and most commonly include meningitis, carditis, and cranial nerve palsies. Late disease is marked by arthritis, encephalitis, and neurological symptoms.

Lyme radiculoneuritis, as seen in our case, represents a manifestation of disseminated Lyme disease. Its mimicry of mechanical injury and relative obscurity (present in only 3% of CDC verified cases of Lyme disease) result in frequent misdiagnosis.[1]

Borrelia is susceptible to most penicillins, tetracyclines, and second and third generation cephalosporins.[12] Oral medication is typically acceptable unless there is involvement of brain parenchyma or high-grade heart block.[4] Typically, doxycycline is the medication of choice as it also treats *Anaplasma phagocytophilium*, a disease that studies suggest 5–20% of patients with Lyme are coinfected with.[12]

Flyers should be grounded for the acute symptoms of Lyme disease, (i.e., headache, fatigue, and viral symptoms). Follow-up is necessary to rule out or treat persistent symptoms. Lyme disease can become debilitating and potentially career-ending if left untreated. Delayed diagnosis appears to result in slower response to therapy as well as predispose to post-Lyme disease syndrome—a constellation of symptoms that include fatigue, pain, and cognitive impairment—making accurate and timely diagnosis and treatment paramount.[6] Furthermore, not only is Lyme disease devastating for an individual pilot, but also their unit/squadron as others must take on an increased workload to complete tasks necessary to carry out their mission. The increased workload coupled with witnessing the physical deterioration of a fellow airman can create a significant emotional burden that impairs performance and compromises mission completion, further highlighting the importance of accurate and timely diagnosis.

In the pilot's initial presentation, the provider misdiagnosed erythema migrans as cellulitis. Premature closure, the bias in which a provider hastily (usually through pattern recognition) comes to a clinical conclusion without considering other possibilities played a critical role in this misdiagnosis, as evidenced by the lack of differential diagnosis listed in the chart and the failure of the provider to ask for a travel history. Confirmation bias, the tendency to only seek out and give credence to information that supports a preexisting belief likely facilitated the premature closure.

The patient's second interaction with the flight surgeon who diagnosed his rash as cellulitis resulted in the misdiagnosis of Lyme radiculoneuritis as Pyriformis syndrome, an error that involved at least three well-described cognitive biases: anchoring, framing effect, and the aforementioned premature closure. Anchoring, allowing information one latches onto from an initial impression of a problem to guide assimilation of new facts at the expense of evaluating the patient through a variety of different lenses with varying baseline assumptions, appears to have played a critical role in this misdiagnosis. The physician anchored on the history of a resolving cellulitis and radicular pain in the setting of recent mountain climbing, causing him to fail to even consider a relationship between the rash and the patient's pain. The unjustified weight he placed on his initial impression of the patient precluded him from evaluating

the patient through the lens of diagnostic parsimony and seeking a unifying diagnosis of the symptoms. Intuition serves as an indispensable tool for physicians, but, at times, the facts used as moors for all other information gathered prevent them from coming to the correct conclusion about a patient's presentation.

The framing effect, the manner in which the patient's case is presented to the provider, also likely contributed to the diagnostic error. If the patient had presented with a rash and radicular pain that manifested simultaneously or even if the patient had not previously received a diagnosis of cellulitis, the provider may very well have considered Lyme disease; however, the patient came with a history of resolving cellulitis and radicular pain that developed while climbing, pieces of information the physician anchored on, and ultimately caused him to misdiagnose the patient. Finally, we again see premature closure playing a role in the provider's misdiagnosis as he attributed the patient's radicular symptoms to Pyriformis syndrome without listing a differential diagnosis in the chart, and conducted a physical exam that consisted solely of musculoskeletal maneuvers, suggesting he gave little, if any, thought to other, nonmusculoskeletal disease processes.

Clinicians necessarily rely heavily on System 1 thinking in clinical practice. However, in order to best care for their patients, they must recognize the shortcomings of System 1 and attempt to also activate System 2 to mitigate the effects of cognitive biases. While multiple suggestions such as computer-based diagnostic aids, structured diagnostic protocols, and education on cognitive biases have been suggested as ways to mitigate errant thinking, simply taking a few seconds to consider other diagnostic possibilities, asking oneself what else the presentation could represent besides the disease that immediately comes to mind has emerged as likely the most efficient and practical means of combatting these biases that cause System 1 thought to reach faulty conclusions, and place flyers and their squadrons/units at risk for preventable harm.[2]

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