What Caused This 8-Year-Old Girl's Limp?

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An 8-year-old nonverbal autistic girl presented with her parents to our emergency department (ED) with a 6-week history of a progressively worsening limp. At onset, the patient had a mild limp, left-sided antalgic gait, avoidance of using the left leg, and expressed discomfort with its manipulation, according to her parents. She was admitted to the hospital for further evaluation of worsening limp.

History

She did not have a history of a musculoskeletal disorders or extremity pain. She had been referred to an orthopedist one month prior to presenting at the ED, at which time Sever disease was diagnosed and a walking boot was prescribed.

Her parents reported that the patient's gait did not improve with the walking boot. Within 2 days of wearing the boot, she had developed a shuffling gait and a fever of 38.2 °C, which had resolved without intervention. Given her continued abnormal gait, new fever, and lack of improvement, an outpatient lower extremity magnetic resonance imaging (MRI) scan was performed by another health care provider, results of which were negative for acute process, according to the parents.

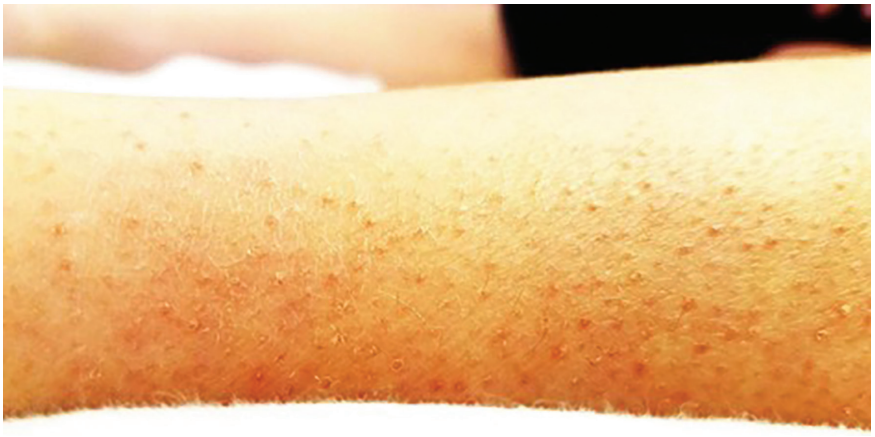

Figure 1. The patient presented with a rash on the lower extremities.

A review of systems revealed that the patient had always been below her optimal weight for her age. Her parents reported that the patient was as an extremely picky eater. Notably, during a recent dental visit, an oral lesion was identified and removed from her hard palate, after which her oral intake had decreased further. A biopsy specimen of the oral lesion was sent for pathology.

Over the 3 months prior to presentation, she had also developed a nonspecific diffuse red rash on the upper and lower extremities. The rash was not painful and was more prominent on the lower extremities (Figure 1). Even though the patient was nonverbal, she was able to sign a limited number of words and follow simple commands.

Physical examination. At presentation, she was afebrile with vital signs within the normal limits. The only significant finding was a low weight of 16.4 kg (0.04 percentile for age; body mass index, 0.9 percentile for age). An oral examination was notable for poor dentition with multiple visible caries and one pustular lesion located centrally along the palate near 2 appropriately healing biopsy sites.

The patient had full range of motion of the bilateral lower extremities without

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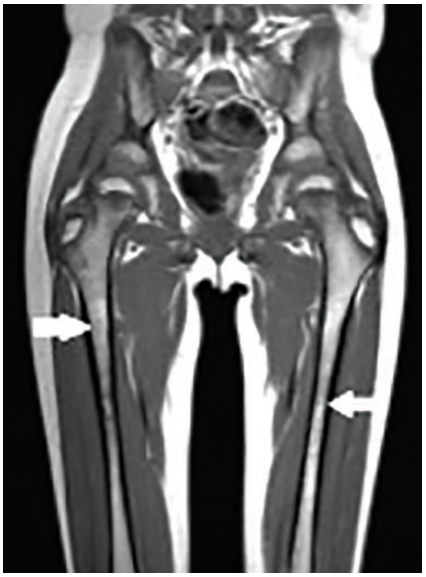

Figure 2. An MRI scan of the patient demonstrated low T1 signal at the metaphyses of the femurs (arrows).

edema, erythema, or tenderness to palpation. Sensation and reflexes were within normal limits throughout. Ambulation demonstrated a slightly wide-based gait with small steps; she appeared visibly uncomfortable with ambulation.

Results of a dermatologic examination revealed diffuse perifollicular hyperkeratotic papules with surrounding petechiae and coiled hairs most prominent on the bilateral lower extremities (Figure 1).

Diagnostic testing

Results of a laboratory workup were significant for elevated levels of aspartate aminotransferase at 71 U/L, alanine aminotransferase at 63 U/L, and lactate dehydrogenase at 283 U/L. Results of a complete blood cell count (CBC), electrolyte panel, erythrocyte sedimentation rate (ESR), and uric acid test were all within normal limits. Previous outpatient testing for Lyme disease, antinuclear antibody, and rheumatoid factor were within normal limits.

A repeat MRI scan of the bilateral lower extremities was performed because of the inability to obtain the previous MRI scan. Results showed bilateral low T1 and high T2 signal involving the metaphyses of the femurs, tibias, and fibulas (Figure 2). During the workup, the biopsy taken during the patient's dental surgery returned results significant for a pyogenic granuloma caused by Actinomyces.

Based on the patient's presentation, laboratory workup findings, and imaging results, what is the most likely cause of this girl's limp?

A. Osteomyelitis
B. Legg-Calve-Perthes disease
C. Local foreign body ingestion
D. Traction apophysitis
E. Malnutrition

Answer: E. Malnutrition

The differential diagnosis for a child with a limp is broad. Adding to the difficulty in this case is the patient's inability to effectively communicate details about her symptoms. Infectious etiologies should be considered first. Diagnoses such as septic arthritis or osteomyelitis would typically present more acutely with fever and an elevated ESR. While a primary neurologic disorder is possible, they more often present with focal neurological deficits. Discerning an antalgic gait from a neurologic gait is challenging in younger patients, and consulting a neurologist may be helpful.

Since our patient was nonverbal, diagnoses such as local foreign body, ankle sprain, referred pain from another site, or other soft tissue injury should also be considered. Additional possible etiologies include bone fracture, Legg-Calve-Perthes disease, slipped capital femoral epiphysis, or traction apophysitis, although these can typically be identified with imaging. Initially, Sever disease had been diagnosed in our patient. However, it is most commonly associated with physical activity such as running and jumping and is inconsistent with our patient's history.

Additional considerations include oncologic processes, which often present with findings of abnormal CBC levels, electrolyte derangement, or focal abnormality on imaging studies. The many causes of arthritis should also be considered but are often associated with an elevated ESR. In this case, our patient's accompanying symptoms of petechial rash, palatal lesion, and inadequate weight gain should also be included when making a diagnosis.

It was observed over multiple meals during her hospital stay the patient would only consume 5 to 6 cups of chocolate milk daily, soft pretzels, fish-shaped crackers, cookies, and a few chicken nuggets. A detailed diet history revealed that, for many years, the patient had refused to eat any fruits or vegetables, which her parents attributed to an aversion to certain textures. This additional diet history, coupled with her petechial rash and limp, led to a high suspicion for malnutrition, specifically vitamin C deficiency. Additional laboratory workup was completed, including tests for thyroid, pre-albumin, and all vitamin levels. The results were notable for a severe deficiency of vitamin C (undetectable) with mild deficiencies of vitamin A, vitamin K, and folate.

Discussion

Vitamin C deficiency results in scurvy, of which there are many examples of affected populations throughout history.[1,2] While scurvy is often considered to be an ancient disease, clinicians should be familiar with the disease process, its manifestations, and the at-risk populations. The diagnosis of scurvy is extremely rare in otherwise-healthy children who consume a typical diet.[3] The typical diet in industrialized countries includes adequate intake of vitamin C. However, in children with scurvy, risk factors include limited access to fruits and vegetables, poverty, and food selectivity.[4] Inadequate intake of vitamin C can lead to depletion of vitamin C levels after one month, and symptoms of scurvy can develop after 1 to 3 months.[5] Other, more salient factors specific to each presentation of this disease should be considered.

In this case, our patient's parents noted that her aversion to certain food textures

severely limited the foods she would eat. Most children with scurvy are similarly associated with extremely restrictive diets, often related to psychiatric or developmental diagnoses.[5] A research team studying 111 children with autism in China found that the average intake of vitamin C did not meet the country's Dietary Reference Intake standards.[6]

Vitamin C is essential for many biochemical reactions that occur in the body; it is most abundant in the form of fresh fruits and vegetables.[7] Of particular interest, as it relates to this case, is the role of vitamin C in collagen synthesis. Vitamin C is part of the reaction that strengthens the structure of collagen.[8] Collagen is present in multiple tissues, notably in vasculature, bone, and teeth. The lack of its structural integrity leads to capillaries that are prone to rupture, thus manifesting as petechiae.[9]

Musculoskeletal symptoms are also common, and in most cases, patients who are eventually found to have scurvy undergo extensive radiographic studies.[3] In our case, the radiologist reported a diffuse signal abnormality within the metaphyses. A case series reviewing MRI scans of patients with scurvy found similar radiographic patterns to those described in our case: diffuse decreased T1 weighted signal with increased T2 weighted signal.[10]

Subperiosteal bleeding is a painful process and is the underlying cause of the common presenting symptom of pain. Gingival disease and dental caries are also common symptoms of scurvy. In this case, our patient had an oral biopsy that returned positive results for *Actinomyces*. When actinomycosis occurs, it is typically associated with an oral lesion and/or poor dentition, which allows entry of the organism.[11] Our patient's poor oral hygiene put her at risk of developing an oral ulcer secondary to an *Actinomyces* species. Since our patient was severely malnourished, she had an additional risk of an opportunistic infection.

Vitamin K deficiency can also manifest with abnormal bleeding, although it typically presents with a purpuric rash and easy bruising. While there may be overlap in this patient's symptoms with vitamin K deficiency, her symptoms were more consistent with scurvy.

Treatment and management

The patient was started on a nasogastric feeding tube for failure to thrive and malnutrition. Supplementation of vitamin C, 250 mg, per day for one month was also initiated, in addition to a daily multivitamin. Daily maintenance dosing of vitamin C is age-dependent, with a range of 30 to 75 mg per day.[1]

To treat the actinomycosis, the patient was started on a 6-month course of penicillin after additional imaging showed no bony erosions or fistulous tracts. The typical recommended treatment duration for actinomycosis is 6 to 12 months.[12] At time of discharge, she was given a wheelchair and referrals for physical and occupational therapy.

Patient outcome

At her one-month follow-up visit, the patient had a normal gait, normal musculoskeletal examination findings, and neurologic examination findings consistent with baseline. Her vitamin C level was within normal limits. At a 3-month follow-up visit, she had complete resolution of the oral ulcer. At one year post-discharge, her weight had steadily increased using a gastrostomy feeding tube to between the 5th and 10th percentile for age.

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