Disseminated Cat Scratch Disease in Pediatric Patients in Hawai‘i

Scarlett Carmen Johnson MD; Jessica Kosut MD; and Natascha Ching MD

Abstract

Cat scratch disease is known to be a generally benign, self-resolving illness associated with non-specific symptoms, including lymphadenopathy, fever, fatigue, anorexia, and headaches. However, it can also cause disseminated disease with a wide range of manifestations, including liver and spleen microabscesses, osteomyelitis, encephalitis, and uveitis. Eighteen pediatric cases of disseminated cat scratch disease at a single center in Hawai‘i are described. This case series emphasizes the importance of disease recognition and use of appropriate diagnostic tools and disease management. The disease burden of pediatric patients with disseminated cat scratch disease in the state of Hawai‘i has a high incidence and should be considered in pediatric patients with prolonged febrile illnesses.

Keywords

Bartonella henselae, *diagnosis, disseminated cat scratch disease, pediatrics, treatment*

Abbreviations

CSD = cat scratch disease
CT = computed tomography
ESR= erythrocyte sedimentation rate
IgG = immunoglobulin G
IgM = immunoglobulin M
KMCWC = Kapi‘olani Medical Center for Women & Children
MRI = magnetic resonance imaging
PCR= polymerase chain reactionTMP-SMX= trimethoprim-sulfamethoxazole

Introduction

Cat scratch disease (CSD) is caused by the gram-negative bacterium *Bartonella*, most commonly *B. henselae*. The primary carriers are cats, who can remain bacteremic for months. Cat-to-cat transmission occurs via fleas, with the organism most frequently transferred to humans via a cat scratch or bite. In most cases, the disease is benign and self-resolving with nonspecific symptoms, including lymphadenopathy (for weeks to months), fever, fatigue, abdominal pain, anorexia, and headaches.[1] However, disseminated CSD, which involves more than lymphadenopathy alone, can occur with wide-ranging manifestations from liver and spleen microabscesses to encephalitis.

B. henselae is endemic to warm, humid climates with studies showing higher incidences in the southern states and California. Despite the warm tropical climate, prior studies have not highlighted the incidence of disseminated CSD in Hawai‘i. Nelson and colleagues reported less than 10 cases of CSD in Hawai‘i over an 8-year period, likely a considerable underestimate given that this included both typical CSD and disseminated cases.[2] This case series demonstrates the high incidence of *B. henselae* in Hawai‘i and describes one of the largest cohorts of disseminated CSD in the current literature. Furthermore, it reviews antibiotic treatment, duration of treatment, and outcomes measurements in these patients to gain a better understanding of the treatment options and to propose potential antibiotic regimens.

Patients and Methods

This series was a retrospective chart review of patients (children aged 18 or younger at time of admission) diagnosed with CSD at Kapi‘olani Medical Center for Women and Children (KMCWC) in Honolulu, Hawai‘i, between 2009 and 2018. KMCWC is a tertiary care medical center and the only children’s hospital in the state of Hawai‘i. Patient medical records from both inpatient and emergency department settings were reviewed using *International Classification of Diseases and Related Health Problems, Ninth Edition* (*ICD-9*) and *International Classification of Diseases and Related Health Problems, Tenth Edition* (*ICD-10*) codes corresponding to CSD, Bartonellosis, liver abscess, spleen abscess, fever of unknown origin, and vertebral osteomyelitis. Cases were then narrowed and verified based on radiologic and lab documentation suggestive of CSD (ie, *B. henselae* polymerase chain reaction [PCR], serology, or imaging indicative of microabscesses or osteomyelitis). Microabscesses in the liver and spleen were described as “hypoechoic” on ultrasonography or “hypodense” on computed tomography (CT) while both “lytic” lesions and marrow enhancement were interpreted as indicative of osteomyelitis on magnetic resonance imaging (MRI) or CT scans. Disseminated CSD was defined as clinical or radiographic evidence of illness involvement beyond that of just lymphadenopathy. Demographic data and the following items were collected from the chart reviews: diagnostic labs and imaging, antibiotic choice and treatment duration, symptom duration, and follow-up studies. Insurance type was used as a surrogate marker for socioeconomic status. This study was considered exempt from review by the Hawai‘i Pacific Health Institutional Review Board (No. 2017-029).

Results

A total of 25 children diagnosed with CSD were identified, 4 were excluded due to incomplete workup. This study reviewed the 18 disseminated CSD cases, 16 of which were hospitalized with 1 patient readmitted after an initial discharge due to persistence of fever.

In the study population, there was a nearly equal gender predilection with 44% male, whereas prior studies had shown a male predilection. Patient demographic and clinical features are displayed in Table 1. Fifteen of the 16 admitted patients reported fever prior to admission; the overall median fever duration was 19 days (range, 3-35 days). Three of the hospitalized disseminated CSD patients had no fever while hospitalized. Median length of hospitalization was 8.5 days (range, 0-15 days). Only 7 cases (39%) had reported or documented lymphadenopathy. Excluding the 1 patient who was readmitted for recurrence of fevers, 12 patients had their fever subside during their hospital stay, ranging from 1 to 11 days into CSD treatment (median, 4 days). Median white blood cell count on presentation was 11.5 (range, 6.7-20.2), with only 2 patients having an elevated white blood cell count. Elevated C-reactive protein and erythrocyte sedimentation rate (ESR) were common but were non-specific, and their elevation did not appear to correlate with disease severity or category. Radiologic studies consisted of ultrasound and CT with 16 patients having an abdominal ultrasound performed, 9 patients underwent abdominal CT, and 8 patients undergoing both as seen in Table 2. In 2 cases, the ultrasound was negative for liver or spleen microabscesses while CT was positive. In 1 case, the CT was negative for microabscesses, but the ultrasound was positive. There was a varied seasonal distribution of disseminated CSD with a peak in the months of February, July, September, and October with 3 cases (17%) in each month. Of the 18 patients, 13 patients had liver or splenic lesions, 4 had osteomyelitis (2 vertebrae, 1 sacrum/iliac, and 1 rib), 1 had uveitis, and 2 had encephalitis. Of the 4 osteomyelitis cases, 1 was diagnosed incidentally via CT of the abdomen and the remainder noted on MRI. The mean patient age was 8.0 years (range, 1 to 15 years; standard deviation, 3.7) with all patients describing prior cat exposure.

None of the *B. henselae* PCR of the blood samples were positive, however, of the disseminated cases, there were positive PCR results for 1 tissue biopsy and 1 lymph node aspirate. Serologic tests were available for 16 cases, 3 of which had initial negative IgM on admission. When comparing day of illness versus IgM titers (Figure 1), IgM often became positive by day 11 and negative by day 40. Eighty-one percent of cases were positive for both *B. henselae* IgG and IgM.

The concurrent workup of patients until CSD was confirmed was extensive, with blood culture, Epstein-Barr virus and Cytomegalovirus serology, and echocardiogram being some of the most frequently ordered tests for patients. Combination therapy was used in all cases, except 2 cases of azithromycin monotherapy with subsequent resolution of fever. The most commonly prescribed combinations were azithromycin and rifampin (8 of 18), or azithromycin, gentamicin, and rifampin (4 of 18) (Table 3). One case of confirmed uveitis was treated with azithromycin, rifampin, and prednisolone as an outpatient. Out of 18 disseminated cases, 5 were lost to follow-up.

Table 1. Demographic and Clinical Features of the Eighteen Children with Disseminated Cat Scratch Disease[a]

		Presenting Clinical Symptoms			
Patient number	**Sex/Age**	**Duration of fever (d)**	**Fever[b]**	**Abdominal pain[b]**	**Other**
1	F/5y	15	(+)	(+)	Headache, diarrhea
2	F/4y	NA	(-)	(-)	Inguinal fullness
3	F/15y	35	(+)	(-)	Headache, neck pain, emesis, back pain, body ache, cough, chest pain
4	M/3y	31	(+)	(-)	Diarrhea, emesis, back pain, leg pain
5	F/7y	3	(+)	(-)	Neck swelling
6	M/13y	21	(+)	(-)	Back pain, anorexia, diarrhea, eye irritation, headache
7	M/6y	21	(+)	(+)	Headache, neck pain, muscle cramps, red eyes
8	M/2y	14	(+)	(-)	Eye irritation, diarrhea, fatigue
9	F/4y	24	(+)	(+)	Headache, constipation, anorexia
10	F/10y	13	(+)	(-)	Headache, rhinorrhea, cough, myalgia, anorexia
11	M/21mo	17	(+)	(-)	Fussy, fatigue, anorexia
12	F/5y	13	(+)	(-)	Unilateral eye redness, less active, anorexia
13	F/11y	11	(+)	(+)	Anorexia, fatigue
14	F/13y	22	(+)	(-)	Headache, back pain, hand edema, fatigue, cracked lips
15	M/3y	19	(+)	(-)	Cough, rhinorrhea, less active, anorexia
16	M/10y	14	(+)	(+)	Headache, back pain, weight loss, dizziness, syncope
17	M/15y	NA	(-)	(-)	Altered mental status, seizure
18	F/9y	NA	(-)	(-)	Fatigue, seizure, altered mental status

Abbreviations: d, days; F, female; M, male; mo, month; NA, not applicable; y, year. [a] All patients had cat or kitten exposure. [b] The symbols "(+)" means present and " (-)" means absent.

Long-term follow-up was variable. In some cases, imaging studies guided duration of antimicrobial therapy with 2 patients having extended treatment due to positive repeat imaging, and 5 patients having resolution of lesions on imaging at planned completion of therapy. Repeat imaging was performed in half of the osteomyelitis cases, but did not affect duration of therapy. Six patients had no repeat imaging at follow-up and only 2 out of the 4 osteomyelitis cases had repeat MRI at follow-up.

Table 2. Clinical, Radiological and Serological Findings for the Eighteen Children With Disseminated Cat Scratch Disease

	Physical examination findings[a]			Abdominal ultrasound lesions in[a]		Abdominal CT lesions[a]		*Bartonella henselae*[a]	*Bartonella henselae* serology[a]		Inflammatory marker
Patient	Fever	HSM	Other	Liver	Spleen	Liver	Spleen	PCR	IgM	IgG	Initial CRP
1	(+)	(-)	None	(-)	(+)	(-)	(-)	(-)	1:128	1:1024	18.1
2	(+)	(-)	Left>right groin fullness	(-)	(+)	NA	NA	(-)	NA	NA	5.2
3	(+)	(-)	Murmur, axillary, cervical and inguinal lymphadenopathy	NA	NA	(+)	(+)	NA	1:16	1:2048	NA
4	(+)	(-)	None	(-)	(-)	(+)	(+)	NA	1:128	1:1024	20.6
5	(+)	(-)	Neck mass	(+)	(+)	(-)	(-)	(-)b	1:16	1:152	2.8
6	(+)	(-)	Murmur, abdomen tender to palpation, inguinal lymphadenopathy	(-)	(+)	NA	NA	(-)	1:256	1:1024	90.9
7	(+)	(-)	Bilateral conjunctivitis, tender foot nodule	(+)	(-)	(+)	(-)	NA	(+)	(-)	103.6
8	(+)	(-)	LUQ fullness, bilateral conjunctivitis	(-)	(+)	(-)	(-)	(-)	1:40	1:128	81.6
9	(+)	(-)	Murmur	(+)	(+)	(+)	(+)	(-)	NA	NA	127.7
10	(+)	(+)	Forearm papule, axillary lymphadenopathy	(-)	(-)	(+)	(+)	(-)	1:128	1:1024	NA
11	(+)	(-)	None	(+)	(+)	NA	NA	(-)	< 1:16	1:512	NA
12	NA	(-)	Unilateral conjunctivitis, dry lips	(-)	(-)	NA	NA	(-)	1:32	1:128	NA
13	(+)	(+)	Nontender cervical lymphadenopathy	(-)	(-)	(-)	(+)	(-)	< 1:16	1:64	220
14	(+)	(-)	None	(-)	(+)	NA	NA	(-)	1:128	1:1024	6.2
15	(+)	(-)	Indurated swelling over left flank	NA	NA	(+)	(+)	(-)b	1:32	1:64	42.1
16	(+)	(+)	Back and right SI joint tenderness to palpation	(-)	(-)	(-)	(+)	(-)	1:256	1:152	21.3
17	(-)	(-)	Left axillary swelling, AMS, seizure	NA	NA	NA	NA	(-)	(-)	1:256	28.1
18	(-)	(-)	AMS, seizure	(-)	(-)	NA	NA	NA	1:16	1:512	2

Abbreviations: AMS, altered mental status; CRP, C-reative protein; CT, computed tomography; HSM, hepatosplenomegaly; IgG, immunoglobin G; IgM, immunoglobin M; NA, not applicable as not obtained; LUQ, left upper quadrant; PCR, polymerase chain reaction; SI, sacroiliac.

[a] The symbols "(+)" means present and " (-)" means absent.

[b] Serum, biopsy, or aspirate Bartonella henselae PCR samples were positive for these patients.

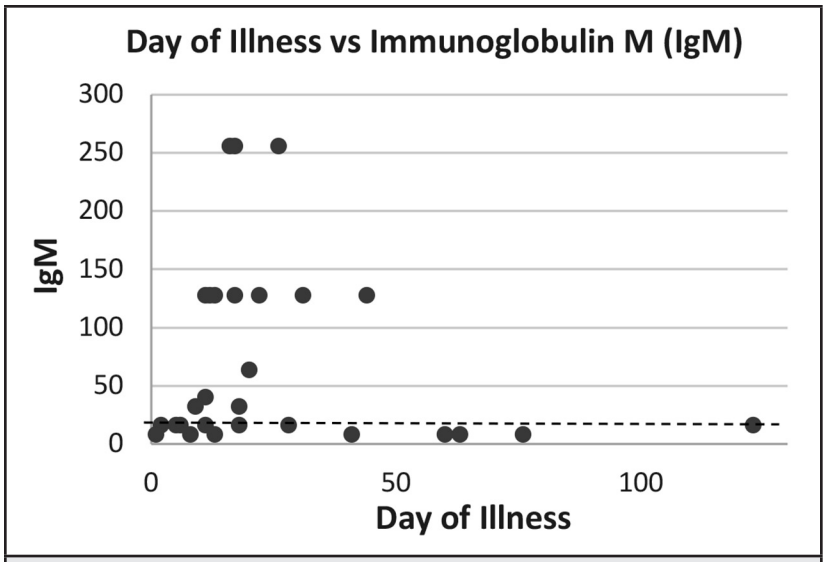

Figure 1. Positive Serological Diagnosis of *Bartonella Henselae* in Pediatric Disseminated Cat Scratch Disease Infections.

Bartonella henselae serological diagnosis measured by IgM versus day of illness. Data points at or above the dashed line (1:16 titers) are considered positive for recent or current infection. Day of illness was defined from onset of fever (or day of hospitalization if afebrile).

Table 3. Treatment Course and Time to Resolution of Fever for the Eighteen Children with Disseminated Cat Scratch Disease

Patient	Disease category	Antibiotic therapy (inpatient/outpatient)	Total duration of treatment (d)	Time to fever resolution[a] (d)
1	liver/spleen abscesses	Az, Rif/Az, Rif	33	0
2	liver/spleen abscesses	NA/Az	5	NA
3a*	liver/spleen abscesses	Gent, TMP-SMX, Az/Gent, TMP-SMX	*	*
3b	liver/spleen abscesses	Gent, Rif, Dox/Rif, Dox	52	3
4	liver/spleen abscesses	Gent, Rif/Rif, TMP-SMX	48.5	3
5	liver/spleen abscesses	Az, Rif/Az, Rif	28	NA
6	liver/spleen abscesses	Az, Rif, Gent/Az, Rif	31	1
7	liver/spleen abscesses	Az, Rif, Gent/Az	37	7
8	liver/spleen abscesses	Az, Rif, Gent/Az, Rif	53.5	11
9	liver/spleen abscesses	Az, Rif, Gent, TMP-SMX/Az, Rif	39	11
10	liver/spleen abscesses	Az, Rif/Az, Rif	33	3
11	liver/spleen abscesses	Az, Rif/Az, Rif	42	2
12	Uveitis	NA/Az, Rif, Pred	58	NA
13	Osteomyelitis	Az, Rif/Az, Rif	21	1
14	Osteomyelitis	Az, Rif/Az, Rif	56	NA
15	Osteomyelitis	Az, Rif, Gent/Az, Rif, Gent	35	5
16	Osteomyelitis	Az, Rif/Az, Rif	35	3
17	Encephalitis	Az, Rif/Az, Rif	18	1
18	Encephalitis	Az/Az	14	2

Abbreviations: Az, azithromycin; d, days; Dox, doxycyline; Gent, gentamicin; NA, not applicable (patient was not hospitalized or did not have a fever); Pred, prednisolone; Rif, rifampin; TMP-SMX, trimethoprim-sulfamethoxazole.

[a] Time to fever resolution is from time of admission.

* Patient 3 was readmitted due to persistent fever, which resolved 3 days into the second hospital stay.

Discussion

According to Bergmans, et al, a diagnosis of CSD usually requires 3 of the following 4 criteria: (1) a history of contact with a cat and the presence of a scratch or primary lesion of the skin, eye, or mucous membrane; (2) a positive cat scratch skin test reaction; (3) negative laboratory testing for other causes of lymphadenopathy; and (4) characteristic histopathological findings in a lymph node biopsy specimen or at a site of systemic involvement.[3] The CSD intradermal skin test is no longer available, culture of *B. henselae* from lymph nodes is difficult, and many patients often do not recall a history of cat injury at the time of admission. Therefore, serological and molecular diagnostic methods are now utilized to diagnose CSD.

Based on the study results, Hawai'i has approximately 3.5 times the incidence of disseminated CSD compared to mainland United States. Over the decade, from 2009–2018, there were 18 cases of disseminated CSD documented at KMCWC. This likely represents most, if not all, diagnosed pediatric cases in the state of Hawai'i, as KMCWC is the only non-military pediatric hospital. National census data show there were 303 568 children living in Hawai'i in 2016; this results in an incidence of 0.593 per 100 000 children, which is much higher than the Centers for Disease Control and Prevention study estimating the inpatient incidence of CSD is 0.19 per 100 000 children.[4,5] Jackson and colleagues found the incidence of CSD cases annually in the United States to be 22 000 cases.[5] Most of the cases presented in February, July, September, and October, which varied from the mainland where most cases occurred in January, with another spike during August through November for inpatient admissions as reported by Nelson and colleagues.[2]

The overall incidence of CSD is likely grossly underestimated because it often self-resolves or its nonspecific symptoms can lead to misdiagnosis. While known to have a tropical climate, it is unclear why Hawai'i would have so many more cases than other humid parts of the United States. One hypothesis is this state has a higher incidence of fleas, wild or stray cats, or a higher bacterial load in the cats with mild weather allowing year-round outdoor exploration and exposure. Recent Hawai'i state congressional resolutions about feral cats suggest that they have grown in their numbers and are an increasing problem in the state.[6] The Western Governors' Association, which includes Hawai'i, identified feral cats as 1 of the top 50 invasive species.[7]

Mainly categorized as an indolent and benign process, CSD can be disseminated, and thus, should be considered early in patients with prolonged fever without a source, even prior to reaching the 14 days of "fever of unknown origin" criteria. It should remain on the differential for patients even in the absence of fever or classic lymphadenopathy. The disseminated cases often occur in patients who are otherwise healthy, and though most have a full recovery, it can result in varying degrees of morbidity, and in rare cases, mortality. Many of these patients, including the ones seen in the current review, present with prolonged fevers and undergo hospitalization with extensive laboratory testing and diagnostic imaging to make the diagnosis. Despite the growing body of literature surrounding disseminated CSD, there remains no formal recommendations regarding diagnostic workup and treatment with great variation in antibiotic choice and duration.[8]

Detection of antibodies against *B. henselae* by immunofluorescence assays or enzyme immune-assay has high sensitivity (88%) and specificity (97%).[9] The diagnostic tool with the highest sensitivity remains *Bartonella* PCR performed on lymph node biopsy or abscess aspirate. CSD has a characteristic pleomorphic rod-shaped bacilli seen with the Warthin-Starry silver stain but bacterial culture has fallen out of favor given the bacterium's slow growth (1-4 weeks) and difficult primary isolation.[1]

A retrospective study by Margileth, et al, revealed shorter mean duration of illness (2.8 versus 14.5 weeks) for those treated with rifampin, ciprofloxacin, gentamicin or trimethoprim-sulfamethoxazole (TMP-SMX) compared to other antibiotics as reviewed by Rolain, et al.[8,10] Though no official treatment is deemed necessary for mild to moderate cases of CSD, a study by Bass, et al, demonstrated faster decrease in lymph node size in uncomplicated CSD cases treated with oral azithromycin for 5 days. The study demonstrated that 8 of 14 patients taking azithromycin had more than 80% improvement at 30 days versus 1 of 15 in the control group; however, both groups had similar resolution beyond the 30-day mark.[11] It has been proposed that the enlarged lymph nodes are an immunologic response and there are no viable bacilli by the time invasive interventions are performed, possibly an explanation for negative cultures but positive PCRs.[8] Arisoy, et al, reported improvement in prolonged fever in patients with hepatosplenic CSD with combination therapy of TMP-SMX when rifampin was added to regimen, commonly for duration of 14 days.[12] Treatment approaches for reported complicated diseases have included azithromycin, rifampin, ciprofloxacin, trimethoprim/sulfamethoxazole, or gentamicin as monotherapy or in combination; however, there remains no formal guidelines regarding treatment of disseminated pediatric cases with hepatosplenic lesions or osteomyelitis.[8]

Study findings are in alignment with the proposition that titers and direct *Bartonella* PCR of tissue or aspirate remain the best diagnostic tools, though repeat titers later in the illness course may be needed if the patient has not yet seroconverted.[9] If there is a high clinical suspicion for CSD in patients with prolonged fever without a source, testing should be sent while initiating empiric treatment, as laboratory test results may not return for several days. Ridder-Schroter and colleagues stated serum PCR is most useful in the first 6 weeks of infection, however, in all of our cases, even when obtained early in the disease course, the serum PCRs were negative.[13] Serum PCR may be of limited utility later in the illness course when the patient is no longer bacteremic and the organism has seeded or is sequestered in

other areas of the body. While positive IgM titers represent active or recent *Bartonella* infection, it should be noted that there is risk of false positives given the prevalence of positive serology in 4-6% of the general population as demonstrated by Puri, et al.[14] Prior studies suggest there is no association between titers and type of clinical presentation, and this study found similar results. There is previous documentation that IgM seropositivity can last up to 3 months but most of the IgM titers were negative by 40 days of illness.[13]

Combination antimicrobial therapy was used in all but one patient with resolution of fever and disseminated disease. Azithromycin with rifampin was part of the treatment regimen in over three quarters of disseminated cases and remains a common first choice. The treatment duration varied widely with no clear correlation with subtype of disseminated disease. The sites of osteomyelitis in these 4 cases were consistent with literature noting *B. henselae* axial predisposition (vertebrae then pelvic girdle, chest wall and skull). Hipp, et al, documented osteomyelitis cases treated with just 3 weeks of azithromycin without follow-up imaging.[15] In Hajjaji's review, mean duration of osteomyelitis treatment was 32 days; however, nearly half of patients received short course antibiotic therapy (less than 6 weeks) and often with monotherapy, yet the prognosis remained good for all.[9] Dornbos and colleagues switched to intravenous doxycycline and rifampin when azithromycin failed and treated until inflammatory markers normalized, stopping despite continued imaging findings.[16] The combination of doxycycline and rifampin has been suggested for central nervous system disease in a study by Rolain, et al, which contrasts the 2 cases presented in this study treated with rifampin and azithromycin antibiotics.[8] Rifampin and gentamicin have been suggested to be bactericidal based on in vitro studies, however, Rolain and colleagues work suggests this is only against bacterium outside erythrocytes. Moreover, minimum inhibitory and bactericidal concentrations often poorly correlate with the in vivo efficacies of antibiotics in patients.[8]

In this case series there was variable duration of therapy based on a combination of resolution of fever, normalization of inflammatory markers, and improvement on imaging studies. The authors propose a standardized first-line treatment regimen of azithromycin and rifampin for all patients with a variation of therapy duration based on organ involvement and clinical response. The authors suggest that CSD osteomyelitis be treated with a similar duration as other causes of osteomyelitis with 21 days of therapy or normalization of C-reactive protein and ESR, whichever is longer. For those with central nervous system involvement, 14 to 21 days of therapy based on clinical response would be appropriate. For patients with hepatosplenic disease, appropriate treatment duration would likely be 21 to 28 days. If clinical response is not sufficient, consideration should be made for adding gentamicin to the treatment regimen. It remains unclear if repeat imaging is necessary in these cases. While normalization of inflammatory markers is frequently utilized to assess disease resolution in other diseases, most CSD patients do not have markedly elevated inflammatory markers, making these unreliable surrogates. In these cases, repeat imaging may assist in determination of successful treatment.

Limitations

Given this is a case series, causality or efficacy cannot be established. Additionally, this study has numerous limitations. Nelson and colleagues' epidemiological study utilized a private insurance base while most of this study's patients have government insurance, which may account for the discrepancy in inpatient incidence.[2] In this study, there were no positive blood cultures among patients but the majority of specimens were not held for the extended 21 days as recommended by the Centers for Disease Control and Prevention. Due to the nature of this retrospective study, some patient follow-up was not accessible or they were lost to follow-up. Finally, coding errors may have led to an incomplete data extraction.

Future Directions

While reviewing the data for this case series, there was a patient admitted with fever of unknown origin. The patient had been evaluated initially as an outpatient but was eventually admitted for inpatient care. The family had been asked about cat exposure and had repeatedly denied it. Multiple serologic studies were sent. A CT scan of the abdomen and pelvis was done to evaluate for an occult abscess, which proved negative. Subsequently, an abdominal ultrasound was done and microabscesses were noted in both the liver and the spleen. The family was then asked again about cat exposure and recalled that the patient's grandmother has kittens. At this time, *Bartonella* serological studies were negative, as could be expected from the results found in this study as the patient was about 30 days into the illness when the labs were drawn. The patient was empirically put on azithromycin and rifampin. Novel testing utilizing cell-free plasma next-generation sequencing test for pathogen detection returned positive for *B. henselae*. This case illustrated how the suspicion for CSD must remain high despite lack of cat exposure in the history, the diminishing utility of *Bartonella* titers later in the course (beyond 40 days), the greater sensitivity of ultrasound finding liver and spleen microabscesses, and the promise of new technology in finding this fastidious organism.

Further studies are needed regarding type and length of treatment, including when to reimage or repeat laboratory testing and if and how this should guide total duration of therapy. Prospective studies would provide the most evidence regarding medication efficacy, complications, and long-term follow-up. Future efforts may also look into defining admission criteria. Collaborating with other facilities with additional CSD cases may allow stronger recommendations regarding noted trends in chart review. One goal of this study is to contribute to existing literature about disseminated CSD and foster awareness and disease understanding, thus facilitating prompt diagnosis, early treatment, and avoidance of unnecessary workup cost.

Conflict of Interest

None of the authors identify any conflict of interest.

Authors' Affiliations:
- Department of Pediatrics, Medical University of South Carolina, Charleston, SC (SCJ)
- Department of Pediatrics, John A. Burns School of Medicine, University of Hawai'i at Mānoa, Honolulu, HI (JK, NC)

Correspondence to:
Natascha Ching MD; 1319 Punahou Street, Room 739, Honolulu, HI 96826;
Email: natascha.ching@kapiolani.org

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