Case Report

Abscess-forming lymphadenopathy and osteomyelitis in children with *Bartonella henselae* infectionRegina Ridder-Schröter,¹ Aleander Marx,² Meinrad Beer,³ Dennis Tappe,⁴ Hans-Wolfgang Kreth¹ and Hermann J. Girschick¹

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Bartonella henselae is the agent of cat-scratch disease (CSD), a chronic lymphadenopathy among children and adolescents. A systemic infection is very rare and most of these cases are found in patients with immunodeficiency. Here, cases involving four children of 6–12 years of age are reported. Three of the children had an abscess-forming lymphadenopathy and surrounding myositis in the clavicular region of the upper arm. The diagnosis was made serologically and, in one case, using eubacterial universal PCR. One child was treated with erythromycin for 10 days, the second received cefotaxime and flucloxacillin for 14 days and the third child was not treated with antibiotics. The fourth child had a different course: a significantly elevated signal intensity affecting the complete humerus was found in magnetic resonance imaging, consistent with osteomyelitis. A lymph node abscess was also found in the axilla. Diagnosis was established by indirect fluorescence assay and lymph node biopsy. Antibiotic therapy using clarithromycin, clindamycin and rifampicin was gradually successful. Immunodeficiency was excluded. All described lesions healed without residues. In immunocompetent patients, infection affects skin and draining lymph nodes; however, prolonged fever of unknown origin as in the fourth patient indicated a systemic complication of CSD.

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Introduction

Bartonella henselae is a pleomorphic, aerobic, Gram-negative bacterium that causes cat-scratch disease (CSD), a common cause of chronic lymphadenopathy among children and adolescents. The typical reservoir for *B. henselae* is cats and young kittens, which transmit the pathogen to humans by scratch or bite. In Germany, approximately 13 % of domestic cats and 16–89 % of roaming cats are seropositive for antibodies to *B. henselae* (Haimerl *et al.*, 1999). Prevalence rates based on the isolation of *B. henselae* were 1 (Arvand *et al.*, 2001) to 13 % for domestic cats (Sander *et al.*, 1997) and 19 % for roaming cats (Arvand *et al.*, 2001). At the site of inoculation, a papule or blister can often be found. Lymphadenopathy occurs primarily in the draining lymph nodes in the axilla or the shoulder region. Infection usually heals within several weeks without antibiotic therapy. In

over 90 % of patients, axillary, cervical, supraclavicular or epitrochanteric lymph nodes are involved. In addition, periauricular, femoral or inguinal lymph nodes may be affected. In 10–20 % of patients more than one group of lymph nodes are inflamed. A variety of rare systemic manifestations have been described, including endocarditis, hepatosplenic involvement (infection and organ rupture), central nervous system involvement (meningitis, encephalitis, neuroretinitis, epilepsy), ocular involvement (uveitis, retinitis) or pulmonary involvement (Bookman *et al.*, 2004; Daybell *et al.*, 2004; Gerber *et al.*, 2002; Puligheddu *et al.*, 2004; Rocha *et al.*, 2004; Martinez-Osorio *et al.*, 2005; Ledina *et al.*, 2004; Prybis *et al.*, 2002; Woestyn *et al.*, 2003; Rost Monahan, 2000). To date, only few cases of osteomyelitis caused by *B. henselae* in children have been reported (Ledina *et al.*, 2004; Prybis *et al.*, 2002; Robson *et al.*, 1999; Abdel-Haq *et al.*, 2005).

Here, we report on four children with abscess-forming lymphadenopathy. One of them was affected by severe osteomyelitis of the humerus. In this extended case report, we describe and discuss the clinical spectrum of CSD

Abbreviations: CSD, cat-scratch disease; ESR, erythrocyte sedimentation rate; IFA, indirect fluorescence assay; MRI, magnetic resonance imaging.

and the diagnosis and treatment in immunocompetent children.

Case reports

Case 1

A 10-year-old girl presented with soft tissue swelling above the right clavicle that lasted 1 week. No trauma was noted. The girl had often played with cats and kittens. The family doctor admitted the girl with the presumed diagnosis of lymphoma. Fever, weight loss, sweating at night or elevated temperature was denied. Physical examination revealed a solid swelling on the right supraclavicular notch (diameter 4 cm), which was somewhat painful at palpation. There was no redness. On the right parasternal region small red papules were present where the kittens had scratched her. Further physical examination was normal. Ultrasound of the right supraclavicular region showed multiple enlarged lymph nodes without abscess formation. Blood tests, radiography of the thorax and abdominal ultrasound were unremarkable (Table 1). Serology for Epstein-Barr virus, cytomegalo virus and *Toxoplasma gondii* was negative. However, IgG antibodies to *B. henselae* were detected using an indirect fluorescence assay (IFA), as described previously by Kempf *et al.* (2001). The cut-off titre of this IFA has been determined at 1:100. Based on the presence of skin papules, regional lymphadenitis and positive serology, the diagnosis of *B. henselae*-associated lymphadenitis was made. The girl was treated successfully with erythromycin for 10 days.

Case 2

A 7-year-old girl was admitted because a painful red swelling had developed on the left infraclavicular region during the past week. She had subfebrile temperatures. Two small crusty papules were present on the left forearm. The family had two adult cats and scratches caused by the cats were reported. Further history was unremarkable. The physical examination showed a tender infraclavicular

swelling with a diameter of 5 cm. In the left cervical region, small lymph nodes with diameters of up to 2 cm were palpable. Further physical examination was normal. Erythrocyte sedimentation rate (ESR) was accelerated (51 mm h^{-1}). Other blood tests and X-rays of the thorax and clavicle were normal (Table 1). The ultrasound showed a $3 \times 3 \times 2 \text{ cm}$ structure of low signal intensity but high overall blood perfusion. A central area of $1.5 \times 0.7 \text{ cm}$ did not give a colour doppler signal consistent with abscess formation. Using magnetic resonance imaging (MRI), osteomyelitis of the clavicle was excluded, but the left M. pectoralis showed signal changes consistent with myositis. A fine-needle-aspiration of the lymph node was performed and pus was aspirated. Therefore, an antibiotic therapy using cefotaxime and flucloxacillin was started empirically and was given for 2 weeks. Microbial aerobic and anaerobic cultures from blood and the aspirate, as well as mycobacterial cultures from the aspirate, were negative. However, *B. henselae* DNA was found in the aspirate using universal 16S rRNA gene amplification and sequencing, as described previously (Girschick *et al.*, 1999, 2005). Thus, the diagnoses of *B. henselae*-associated lymphadenitis and myositis were made. As the symptoms had already improved significantly, no additional therapy was implemented after the PCR results had been obtained.

Case 3

A 6½-year-old girl was admitted to the hospital with an acute swelling of the left distal arm close to the elbow. Extension in the elbow joint was painful and limited. Two weeks earlier, a blunt trauma to this arm had been noticed. Fever, weight loss, night sweat or reduced appetite was denied. There was no swelling of lymph nodes elsewhere. There was a close contact with adult cats. Six months earlier, an abscess-forming skin lesion on the right knee (diameter of 1 cm) had been noted, which resolved spontaneously. Physical examination showed a tender swelling. Motion of the left elbow joint was impaired. Further physical examination was normal. Blood tests were normal, except for an ESR of 27 mm h^{-1} (Table 1). An

Table 1. Clinical and diagnostic criteria of four patients suffering from CSD

Abbreviations: CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; IFA, indirect fluorescence assay [cut-off titre in patient 1, 1:100 (Kempf *et al.*, 2001); cut-off titre in patients 3 and 4, 1:64 (Sander *et al.*, 2001)]; RA, reticuloendothelial abscess forming lymphadenitis. ND, Not done; NE, not elevated.

Patient	Contact with cats	Temperature (°C)	Skin lesions	Lymphadenitis	Osteomyelitis	CRP (mg dl ⁻¹)	Leukocytes (µl ⁻¹)	ESR (mm h ⁻¹)	Histology	Serology (IFA)
1	+	NE	+	+	—	NE	8000	9	ND	IgG+ (1:200)
2	+	NE	+	+	—	1.3	10 320	51	ND	ND (<i>Bartonella</i> -rRNA+)
3	+	NE	—	+	—	NE	7070	27	RA	IgG+ (1:256)
4	+	38.3	+	+	+	1.4	4380	101	RA	IgG+ (1:1024)

Fig. 1. Clinical status of patient 4. This patient presented with painful reddish swelling of the right upper arm. Movement in the elbow joint was limited.

ultrasound showed a soft tissue mass and surrounding oedema consistent with myositis. A malignant disease could not be excluded. Therefore, a biopsy was performed. Histopathology revealed a reticuloendothelial, abscess-forming lymphadenitis. Subsequently, a positive IgG titre for *B. henselae* was documented (IFA) (Sander *et al.*, 2001). The cut-off titre of this IFA has been determined at 1:64. The diagnoses of *B. henselae*-associated myositis and lymphadenitis were made. The girl was not treated with antibiotics because clinical severity was limited and spontaneous improvement was noted. A follow-up examination after 3 weeks showed further improvement, and another follow-up 3 months later was unremarkable.

Case 4

A 12-year-old girl was admitted with a swelling of the right upper arm that had been present for 3 weeks (Fig. 1). She had had a moderate fever for 7 days and had been coughing for 3 days. On the right parasternal rib-arc there were four

small itchy red papules. On the dorsum of the right hand some cat scratches and another papule were noted. The family had several adult cats and a dog. Physical examination was otherwise normal, except for an elevated temperature of 38.3 °C. The ESR was 101 mm h⁻¹ and the C-reactive protein was 1.4 mg dl⁻¹. Additional blood tests were normal. The ultrasound of the right elbow notch showed multiple lymph nodes of low signal intensity with diameters of up to 2 cm. A conglomerate of enlarged lymph nodes (4 cm in diameter) in the right axilla was noted. In the biceps a diffuse increase of ultrasound signal intensity could be seen, suggesting local myositis. MRI was suggestive of osteomyelitis in the humerus: strong T2-weighted MRI using fat suppression technique (TIRM) revealed a significantly increased signal, and T1-weighted images before and after gadolinium showed a gadolinium enhancement in the humeral metaphysis and diaphysis (Fig. 2). Other diagnostics (echocardiography, ECG, radiography of the thorax, abdominal ultrasound) were normal. A biopsy of the axillary lymph nodes showed a reticuloendothelial, abscess-forming lymphadenitis (Fig. 3). Lymphoma or other malignancies were excluded. Blood cultures and cultures from biopsy tissue were negative for aerobic and anaerobic bacteria, mycobacteria and fungi. Infection by *B. henselae* was suspected based on the cat-scratch history and the presence of skin papules at scratch sites, in addition to lymphadenitis. However, initially no anti-*B. henselae* antibodies could be detected (IgG titre of below 1:32 in IFA; Sander *et al.*, 2001). Seven days later, the antibody levels had still not risen. However, after another 18 days anti-*B. henselae* IgG antibodies were detected (titre of 1:1024, IFA). Therefore, the diagnosis of *B. henselae*-lymphadenitis with myositis and osteomyelitis was made. Interestingly, the mother of the patient was also positive for IgG antibodies against *B. henselae* (titre of 1:128, IFA). Therapy with clarithromycin for 10 days had been started initially, but the fever and inflammation did not disappear. The therapy was therefore changed to clindamycin and rifampicin. After 11 days, the symptoms

Fig. 2. Diagnostic MRI of patient 4. (a) Strong T2-weighted MRI using fat suppression technique (TIRM) of the right upper arm revealed a significantly increased signal in the humerus, consistent with osteomyelitis. (b and c), T1-weighted image before (b) and after (c) gadolinium enhancement, showing a gadolinium enhancement of the humeral metaphysis and diaphysis.

Fig. 3. Histopathology of the lymph node biopsy of patient 4. (a) Histology of the lymph node revealing a reticuloendothelial, abscess-forming lymphadenitis with irregular linear abscesses surrounded by palisaded histiocytic and epithelioid cells. (b) Vasculitis lesion with multinucleated giant cells present (arrow). Haematoxylin-eosin staining; magnification $\times 200$.

had resolved completely; therefore, the antibiotics were stopped. Immunodeficiency was considered as a potential reason for this particular severe manifestation of CSD; however, this seemed unlikely because patient history and laboratory tests including peripheral leukocyte counts, lymphocyte subpopulation analysis and granulocyte function tests, in addition to serum IgG plus subtypes, IgA and IgM titres and the presence of antibodies to vaccine antigens (diphtheria and tetanus toxoid antigens), were unremarkable.

Discussion

In 75% of patients the course of CSD is without complications; less than 50% of patients have fever (Massei *et al.*, 2005). However, in 6% of infections, *B. henselae* causes an oculo-glandular syndrome that affects conjunctiva and preauricular lymph nodes (Lamps & Scott, 2004). Hepatosplenic (Daybell *et al.*, 2004; Pelton *et al.*, 2006), cardiopulmonary (Bookman *et al.*, 2004) and renal (Liao *et al.*, 2006) involvements have been described.

Neurological symptoms including neuritis of the optic nerve, encephalitis, polyneuritis or cerebral stroke have been noted up to 6 weeks after lymphadenopathy had appeared (Gerber *et al.*, 2002; Puligheddu *et al.*, 2004; Rocha *et al.*, 2004). There are only a few case reports on patients with *B. henselae*-associated osteomyelitis (Ledina *et al.*, 2004; Prybis *et al.*, 2002; Woestyn *et al.*, 2003), including children (Robson *et al.*, 1999; Abdel-Haq *et al.*, 2005). In immunodeficient people, *B. henselae* causes a vasoproliferative process called bacillary angiomatosis (Koehler *et al.*, 1997). The reason why patient 4 suffered from the rare manifestation of *B. henselae*-associated osteomyelitis is unclear. The affected child's immune system appeared to be competent. CSD appears to be a disease of childhood and adolescence: 80% of patients are below 21 years of age. In contrast, Ridder *et al.* (2002) found a median age of 33.9 years (range 4–89 years) in a study of 61 CSD patients. Infections caused by *B. henselae* have been reported worldwide. Cats and in particular young kittens are the typical reservoir. *B. henselae* is transmitted from cats to humans predominantly by cat scratches or bites. Fifty-seven (Ridder *et al.*, 2002) to 90% (Lamps & Scott, 2004) of patients had proven contact with cats. No transmission from person to person has been described. However, familial outbreaks due to contact with the same animal have been reported, similar to that in family no. 4. Cat fleas, which represent the main vector for transmission of *B. henselae* among cats, may function as additional vectors for the transmission to humans. Infection of dogs or monkeys appears to be possible (Lamps & Scott, 2004).

B. henselae is a facultative intracellular bacterium with a tropism for endothelial cells, which are entered by means of endocytosis (Lamps & Scott, 2004; Rolain *et al.*, 2004). The pathogen can persist in erythrocytes and therefore remains in the bloodstream (Rolain *et al.*, 2004). Mändle *et al.* (2005) showed that infection of human CD34+ progenitor cells with *B. henselae* results in the intraerythrocytic presence of the pathogen.

Diagnosis is made by clinical examination and serology. Metzko-Cotter *et al.* (2003) showed that there is no particular association between the bartonella-specific antibody titre and the type and severity of the clinical manifestation. In 98 patients with CSD, they showed that IgM-seropositivity lasts for about 3 months, using an enzyme immunoassay. Patients can remain seropositive for IgG for more than 2 years after infection (Metzko-Cotter *et al.*, 2003). In a retrospective study with 508 unselected children and adolescents without any clinical signs and symptoms of CSD, Massei *et al.* (2004) showed that there was a high seroprevalence of bartonella-specific antibodies, supporting the hypothesis that *B. henselae* infection is often asymptomatic in young children and resolves spontaneously in most cases. As in Case 1 in this study, CSD may be clinically indistinguishable from lymphoma. Thus, biopsy is often necessary to establish a definite diagnosis. However, isolation of *B. henselae* from biopsy tissue or

blood culture is often unsuccessful. PCR-based genetic analysis may be helpful during the first 6 weeks of infection (Hansmann *et al.*, 2005). We used a universal eubacterial PCR approach to amplify ribosomal genes in patient 2 (Girschick *et al.*, 1999).

Therapy for *B. henselae* infections is still controversial. At the moment it is not clear whether an antibiotic therapy in immunocompetent patients with CSD has any advantage over no therapy. The current recommendation for mild to moderately ill immunocompetent patients is to 'wait and see' after the diagnosis has been confirmed (Rolain *et al.*, 2004; Koehler & Duncan, 2005). Supportive analgesic and anti-inflammatory treatment may be useful. If antibiotic therapy is necessary (i.e. in patients with very large lymph nodes or complicated disease), erythromycin, clarithromycin or azithromycin have been used successfully (Bass *et al.*, 1998). A combination of rifampicin and doxycycline can be used as an alternative regimen (Rolain *et al.*, 2004). The latter combination has been used successfully in complicated CSD, and in patients with neuroretinitis or central nervous system disease (Rolain *et al.*, 2004).

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