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ORIGINAL ARTICLE

Clinical findings in parvovirus B19 infection in 30 adult patients in Kyoto

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Abstract To relate the clinical findings of parvovirus B19 infection to the phase of the disease, we performed a retrospective chart review of 30 adult patients who tested positive for IgM antibody against parvovirus B19 at our hospital from March 2003 to November 2008. Median patient age was 38 years, with 86.7% aged between 26 and 45 years. The male-to-female ratio was 4:26 (86.7% female). Symptoms in the first phase were mainly flu-like, including fever, headache, or myalgia. Symptoms in the second phase were arthralgia in 24 (85.7%) and rash in 23 (82.1%). Fever was observed in 21 (70.0%), and 22 (75.9%) were found to be lymphopenic. The onsets in 73.3% of cases were concentrated within 10.1% of the study period, an observation nearly consistent with an outbreak of erythema infectiosum. Three patients had symmetrical swelling of joints, all of whom also had rash. Most patients visited the hospital within a week of onset and prognosis was favorable. In the parvovirus B19 infection, flu-like symptoms were frequent in the first phase, while rash and arthralgia were common in the second. Female sex, age between 26 and 45, and presence of rash, arthralgia, fever, and lymphopenia were clinical findings with a high frequency (≥70%), and these factors may contribute to diagnosis. In an era when early diagnosis and therapy is required in rheumatoid arthritis, it is important to recognize the parvovirus B19 infection with a presentation of acute arthritis and a favorable prognosis.

Keywords Adult · Erythema infectiosum · Outbreak · Parvovirus B19

Introduction

Clinical presentation associated with parvovirus B19 infection varies significantly between patients in accordance with the individual's age and hematologic and immunologic status. The following five well-established syndromes are associated with parvovirus B19 infection: transient aplastic crisis in individuals with chronic hemolytic disorders, persistent parvovirus infection, hydrops fetalis, fifth disease, and arthropathy [1]. Although parvovirus B19 infection in adults has been well investigated [2–7], no large-scale study has examined clinical manifestations or laboratory data by phase of parvovirus B19 infection.

The clinical course according to disease phase in a healthy adult was well demonstrated in an experimental study in which nine healthy volunteers were intranasally inoculated with the virus [8]. The disease course followed a

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typical biphasic pattern, consisting of a viremic phase and an antibody response phase. The viremic phase was evident within the first week after inoculation, consisting of non-specific flu-like symptoms such as fever, malaise, myalgia, headache, and pruritis, accompanied by hematologic abnormalities such as anemia, leukopenia and thrombocytopenia. The more characteristic symptoms of parvovirus B19 infection, namely rash and arthralgia, occurred in the second week.

Here, we performed a retrospective study of 30 immunocompetent subjects infected with parvovirus B19, the largest hospital-based study to date, including an analysis of clinical data according to disease phase as well as data regarding environmental factors.

Patients and methods

The present study was conducted at Rakuwakai Otowa Hospital, the largest teaching hospital in Yamashina-ku, a southeastern ward of Kyoto City with a population of approximately 136,000. A computerized data collection system was used to identify patients who had undergone enzyme immunoassay for IgM antibody against parvovirus B19 at our hospital between March 2003 and November 2008. Enrollment criteria were an age of between 15 and 100 years, and detected levels of antibody against parvovirus B19, defined as $\geq$1.0. Patients with an equivocal (0.8–0.99) or negative (<0.8) antibody level were excluded. We conducted a retrospective chart review on the patients. The first and second phases of infection were defined as the period before and after the onset of rash or arthralgia, respectively, and symptoms and physical findings were subsequently recorded according to these phases. Laboratory data were derived from a blood sample drawn at our hospital, and included measurements for white blood cells (WBCs), neutrophils, lymphocytes, hemoglobin, reticulocytes, platelets, serum levels of alanine aminotransferase (ALT), lactate dehydrogenase (LDH), C-reactive protein (CRP), C3, C4, total hemolytic complement (CH50), rheumatoid factor (RF), and antinuclear antibody (ANA). Urine analysis by dipstick, including assessment of proteinuria and urine occult blood, was also conducted. Results were expressed as mean $\pm$ SD.

Statistical methods

Continuous and categorical variables in the two phases were compared by unpaired t test or Mann–Whitney test and by Fisher's exact test, respectively, using STATA ver. 10 (STATA Corporation, College Station, TX, USA). Statistical significance was set at $p < 0.05$ for all tests.

Results

Among the 119 analyses performed to detect IgM antibody in 117 patients, positive results were attained for 34 patients. Four of the 34 were excluded because they concomitantly had cytomegalovirus infection, systemic lupus erythematosus, myelodysplastic syndrome that progressed to acute leukemia, and acute myocarditis; the other 30 patients were finally enrolled into the study.

Patient characteristics

Patient characteristics are listed in Table 1. Median patient age was 38 years (range 25–65 years), with 26 (86.7%) aged between 26 and 45 years. The male-to-female ratio was 4:26 (86.7% female). Twenty-two (84.6%) of the 26 female patients were between the ages of 26 and 45, while all four male patients were within this range. No patients were pregnant.

The following underlying diseases were observed in six patients: iron-deficiency anemia in three; angina pectoris, hypertension and hyperlipidemia, and cold urticaria in one patient each. With regard to the 24 patients for whom family history was available, eight (33.3%) had a child who became infected with erythema infectiosum during the follow-up period. With regard to the 13 patients who were interviewed about their place of work, six (46.2%) were hospital staff, including two (15.4%) nurses at an outpatient clinic, one (7.7%) was a receptionist, and one (7.7%) was a medical technologist; two (15.4%) were staff at a kindergarten; and two (15.4%) were staff at a restaurant.

Symptoms

First visits to our hospital were made by eight (26.7%) patients during the first phase and 22 patients (73.3%) during the second phase. Fifteen of the 30 patients (50.0%) showed a typical course of infection, namely onset of the second phase, including rash or arthralgia, which occurred one or several days after observing the first phase. The mean duration from the onset of the first phase to that of the second was 5.5 $\pm$ 3.2 days (range 1–12 days). Two of the eight first-phase patients and 13 of the 22 second-phase patients never had any symptom of another phase.

First-phase symptoms in 17 patients, including the 8 patients in the first phase and the nine evaluable patients of the 22 in the second phase, were as follows (Table 2). Fever ($\geq$37°C) and high fever ($\geq$38°C) were observed in 13 (76.5%) and in 11 patients (64.7%), respectively. High fever was often accompanied by a flu-like illness, including headache, myalgia and malaise. Gastrointestinal symptoms were observed in five patients (29.4%) and sore throat in one (5.9%). No patients reported nasal discharge, cough,

Table 1 The characteristics of the patients

No.	Age	Sex	Phase[a]	Symptom in the 1st phase	Arthralgia (in the 2nd phase)	Rash (in the 2nd phase)
1	31	F	1	Appetite loss with loose stool, malaise, high fever, headache	Knees, elbows, ankles	Small erythemas agglutinating to each other
2	34	F	1	Watery diarrhea, high fever with shivering	Hands, feet, knees	Multiple faint erythemas in extremities and truncus
3	45	M	1	High fever with shivering and arthralgia, headache, vomiting, myalgia	None	None
4	44	F	1	High fever with chillness, arthralgia and headache, malaise	Fingers and toes	Lacy rash in thighs followed by erythema in cheeks
5	39	F	1	Headache, malaise, nausea, high fever, shivering, myalgia and arthralgia	Arthralgia	Erythemas across whole body
6	35	M	1	High fever, myalgia, headache, sore throat	None	None
7	25	F	1	High fever with headache and arthralgia, myalgia	None	Lacy rash with itching in abdomen
8	39	F	1	Headache, malaise, myalgia	Migratory in PIPs, wrist, knee, ankle, shoulder	None
9	45	F	2	High fever	Knee, hand, finger	Spotted erythema in extremities
10	39	F	2	Myalgia	Wrists, 1st MTPs, knees, feet	None
11	42	F	2	High fever, conjunctivitis, malaise	Hands	Faint lacy erythema
12	35	M	2	Pruritis	Knee, elbow, shoulder	Small erythemas across whole body
13	37	F	2	High fever	Knees, feet	Faint lacy erythema in extremities
14	65	F	2	LGF, malaise, myalgia	None	Erythema in inguinal regions and faint erythema on back
15	39	F	2	LGF	Knee, feet, hands	Erythema in thighs and upper extremities
16	32	F	2	High fever	Arthralgia	None
17	38	F	2	Watery diarrhea	Knee, wrist	Small erythema in extremities
18	36	F	2	None	Feet	Erythema with itching in legs and forearms
19	43	F	2	None	Arthralgia	Faint erythema in extremities
20	60	F	2	None	Elbows, shoulders, hips, knees	Small eczema in extremities and petechia in legs
21	40	F	2	None	Hands, feet	None
22	53	F	2	None	None	Petechia on legs
23	29	F	2	None	None	Redness in cheeks and faint erythema with itching in extremities
24	38	F	2	None	All joints including hands and shoulders	Disseminated erythema in hands and feet
25	39	F	2	None	Finger, foot	Small erythema in extremities and abdomen
26	37	F	2	None	All joints in symmetrical pattern	Faint small erythemas across whole body
27	32	F	2	None	Arthralgia	Reticular erythema in extremities
28	27	M	2	None	Knee	Reticular erythema on thighs and hands
29	31	F	2	None	Knees, foot, finger, elbow, shoulder	None
30	37	F	2	None	All joints including fingers	Erythema with itching hands and rt. Thigh and erythema in cheeks

LGF low-grade fever, *PIPs* proximal interphalangeal joints, *MTPs* metatarsophalangeal joints

[a] The phase at which the patient first visited us; the first and second phases are expressed as 1 and 2, respectively

Table 2 The symptoms in the first and the second phases

	No. of patients	% of the evaluable	% of 30
Symptoms in the 1st phase			
Fever (≥37°C)	13/17	76.5	43.3
High fever (≥38°C)	11/17	64.7	36.7
Shivering	3/17	17.6	10.0
Headache	5/17	29.4	16.7
Myalgia	8/17	47.1	26.7
Malaise	6/17	35.3	20.0
Gastrointestinal symptom	5/17	29.4	16.7
Watery diarrhea	2		
Loose stool with appetite loss	1		
Vomiting	1		
Nausea	1		
Sore throat	1/17	5.9	3.3
Conjunctivitis	1/17	5.9	3.3
Pruritis	1/17	5.9	
Symptoms in the 2nd phase			
Arthralgia	24/28	85.7	80.0
Rash	23/28	82.1	76.7
Edema	13/28	46.4	43.3
Fever	13/28	46.4	43.3
High fever	3/28	7.1	10.0
Throughout both phases			
Fever	21/30	70.0	70.0
High fever	12/30	40.0	40.0

sputum, or symptoms of a urinary tract infection. Given that the incubation period of parvovirus B19 is less than three weeks [9], the upper respiratory infection symptoms lasting longer than three weeks in two patients were found to be unrelated to the virus infection.

With regard to second-phase symptoms, either rash or arthralgia was observed in 28 patients, while both were absent in two (Table 2). Evaluation of the 28 patients with a second-phase symptom showed arthralgia in 24 (85.7%), rash in 23 (82.1%), and both in 19 (67.9%). The sites of arthralgia in the 20 evaluable patients are shown in Table 3. More than half (60.0%) of the evaluable patients reported knee pain, while 13 patients (46.4%, second phase only) complained of edema, with ten experiencing it in the extremities and four in the face.

Throughout the first and second phases, fever was observed in 21 patients (70.0% of all) and high fever in 12 (40.0% of all).

Physical examination

Physical examination of the joints was performed in 19 patients (Table 4). Tenderness and swelling of any joint

Table 3 Site of arthralgia in evaluable 20 patients

Site	No. of cases	%
Knee	12	60
Foot	8	40
Hand	6	30
Finger	6	30
Shoulder	5	25
Elbow	4	20
Wrist	3	15
Ankle	2	10
Toe	2	10
Hip	1	5

Metacarpophalangeal, proximal and distal interphalangeal joints were included in "finger," and metatarsophalangeal and interphalangeal joints were in "toe"

Table 4 Physical examination

	No. of cases	% of those examined	% of 30
Arthritis			
Tenderness	7/19	36.8	23.3
Swelling	3/19	15.8	10.0
Rash			
Erythema	20/23	87.0	66.7
Reticular or lacy rash	6/23	26.1	20.0
Petechial rash	2/23	8.7	6.7
Itching	3/23	13.0	10.0
In extremities	19/21	90.5	63.3
In trunk	7/21	33.3	23.3
In face	2/21	9.5	6.7
Lymphadenopathy	13/25	52.0	43.3
Cervical	12/25	48.0	40.0
Axillary	2/25	8.0	6.7
Inguinal	1/25	4.0	3.3
Retroauricular	1/25	4.0	3.3
Edema in legs	4/10	40.0	13.3

was observed in seven (36.8%) and three (15.8%), respectively. Distributions were symmetrical in the three patients with swollen joints, with swelling in the metacarpophalangeal (MCP) joints in two, the proximal interphalangeal (PIP) joints in two, and the knees in one. For 21 of the 23 patients who experienced a rash, the site of occurrence was the extremities in 19 (90.5%), the trunk in seven (33.3%), and the face in two (9.5%). Observed skin lesions were recorded as erythema in 20 of 23 patients (87.0%), reticular or lacy rash in six (26.1%), and petechial rash in two (8.7%). Four (17.4%) of the 23 patients experienced itching concomitantly with rash. Lymphadenopathy was found in 13 of 25 evaluable patients (52.0%),

Table 5 Laboratory data

	No. of cases	% of thosee who were evaluable	% of 30
Number of patients with abnormal data			
Leukopenia (<4000/mm^3)	13/29	44.8	43.3
Neutropenia (<1500/mm^3)	6/29	20.7	20.0
Lymphopenia (<1500/mm^3)	22/29	75.9	73.3
Anemia (Hb <13.5 g/dl in males, <11.5 g/dl in females)	8/29	27.6	26.7
Thrombocytopenia (<150000/mm^3)	9/29	31.0	30.0
Elevation of ALT (>40 IU/l)	2/29	6.9	6.7
Elevation of LDH (>260 IU/l)	2/29	6.9	6.7
Elevation of CRP (>0.24 mg/dl)	12/29	41.4	40.0
Proteinuria	2/14	11.8	6.7
Urine occult blood	0/14	0.0	0.0
Decrease of C3	5/8	62.5	16.7
Decrease of C4	4/8	50.0	13.3
Decrease of CH50	4/9	44.4	13.3
Positive RF	0/12	0.0	0.0
Positive ANA	6/14	42.9	20.0

	All of patients	7 patients in the 1st phase	22 patients in the 2nd phase	p value*
Mean level				
WBC	4521 ± 2110/mm^3	2314 ± 1259/mm^3	5223 ± 1828/mm^3	0.0003
Neutrophil	3045 ± 1776/mm^3	1362 ± 1023/mm^3	3581 ± 1631/mm^3	0.0011
Lymphocyte	1036 ± 501/mm^3	633 ± 549/mm^3	1165 ± 420/mm^3	0.0057
Hemoglobin	12.4 ± 1.8 g/dl	13.3 ± 2.0 g/dl	12.1 ± 1.6 g/dl	0.0661
Platelet	190000 ± 70000/mm^3	114000 ± 38000/mm^3	214000 ± 60000/mm^3	0.0001
ALT	22.8 ± 9.2 IU/l	17.1 ± 3.4 IU/l	24.6 ± 9.9 IU/l	0.0312
LDH	210.0 ± 41.3 IU/l	184.4 ± 40.3 IU/l	218.5 ± 38.8 IU/l	0.0410
CRP	0.45 ± 0.78 mg/dl	0.67 ± 0.70 mg/dl	0.38 ± 0.80 mg/dl	0.0218

* Between the first and second phases

consisting of four patients in the first phase and 11 in the second. In two of these four first-phase patients, lymphadenopathy was also observed in the second phase. Of the remaining two, second-phase lymphadenopathy was not evaluable in one (due to the absence of the second phase) and was not noted in the other. The site of lymphadenopathy was cervical in 12, axillary in two, and retroauricular and inguinal in one patient each. Edema was observed in for of ten evaluable patients (40.0%), in the legs in all cases.

Laboratory data

Laboratory data for the 29 evaluable patients are shown in Table 5. With respect to blood assessment parameters, the frequency of lymphopenia (<1500 lymphocytes/mm^3) was 75.9%, higher than all the other assessed factors. Leukopenia (<4000 WBC/mm^3) was noted in 44.8% of patients, neutropenia (<1500 neutrophils/mm^3) in 20.7%, anemia (<13.5 g/dl hemoglobin/dl in males, <11.5 g/dl in females) in 27.6%, and thrombocytopenia (<150000 platelets/mm^3) in 31.0%. Biochemical evaluation showed elevated levels of ALT, LDH, and CRP in 6.9, in 6.9, and in 41.4%, respectively. However, in both of the two patients with elevated levels of ALT, values were only slightly elevated (41 IU/l for both patients; normal ≤40). Levels of complement were measured only in the second phase, and hypocomplementemia was found in half of our patients. RF was absent in all 12 evaluable patients, and ANA was found in six of the 14 evaluable patients, all of whom had values of 40-fold (normal: <40-fold). The level of proteinuria was 1+ in two patients, and ± in two, giving positive values (1+) in two of the 17 patients (11.8%). No urine occult blood was found in any of the 17 patients.

Although our study included eight patients in the first phase, the first blood sample from one-first-phase patient (Patient 8) was drawn in the second phase, and was thus included as second-phase data, while no laboratory data

except IgM antibody against the virus were available for another patient in the second phase (Patient 28). We therefore compared laboratory data between seven samples in the first phase and 22 in the second. Mean levels of WBCs, neutrophils, lymphocytes, and platelets were significantly lower in the first phase of infection than in the second. In contrast, mean levels of ALT and LDH were significantly higher in the second phase than in the first, although mean levels of CRP were higher in the first. No significant differences in other variables were noted (data not shown).

Outbreak

The date of antibody measurement was assessed for the 30 patients. For this study, we defined an outbreak as a frequency of ≥2 cases per month; this criterion was met from May to October 2006, and in January 2007, and an outbreak was therefore defined as occurring in these months. Onset of infection in 22 (73.3%) of these 30 patients was concentrated in this seven-month period, which accounted for 10.1% of the total study period. Sentinel surveillance of 41 children's hospitals in Kyoto, provided by the Kyoto City Institute of Health and Environmental Sciences [10], showed that an outbreak (defined in our study as ≥2 cases per month at a single children's hospital) was observed from April to July 2006 and in January 2007, findings that appeared to associate with our own findings in adults (Fig. 1).

A comparison of the following variables showed no significant difference with regard to onset during or outside of the outbreak; sex ratio; presence of arthralgia; rash; fever; high fever; lymphadenopathy and edema; values for WBCs, neutrophils, lymphocytes, hemoglobin, platelets, ALT, LDH, or CRP; presence of low C3 and low C4; presence of proteinuria; and the positivity of ANA (data not shown).

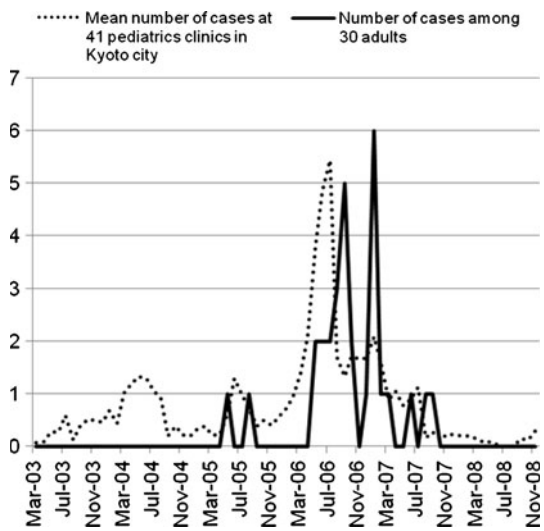

Fig. 1 Number of cases per month with parvovirus B19 infection among 30 adults, and the mean number of erythema infectiosum cases per month noted on sentinel surveillance of 41 children's hospitals in Kyoto City [5]

Clinical course and prognosis

The mean period between the onset of symptoms and the patient's first visit to a medical institution was 5.6 ± 6.6 days, and the mean period between the first visit and the measurement of the antibody was 3.9 ± 6.3 days.

Improvement of symptoms reported by patients was observed in all of the 22 patients for whom prognosis was available. Prognosis in the remaining eight patients was unavailable, and three of them were not followed due to a benign course of infection.

For the joint symptoms, the mean period between the onset of arthralgia and the patient's first visit in the 19 evaluable cases was 4.7 ± 6.1 days (range 0–22 days). Arthralgia improved in 15 patients within a mean period of 11.5 ± 8.9 days (range 2–36 days) between onset of arthralgia and significant improvement. With regard to the remaining nine patients, arthralgia persisted for an average of 7.6 ± 6.0 days (range 0–21 days) until the last visit of the nine, with none returning for joint-related symptoms.

Typical case (Patient 5)

A 44-year-old woman visited our hospital with a two-day history of flu-like illness, including high fever, chills, malaise, and headache on fervescence. Although the patient had a history of iron-deficiency anemia, she had stopped medication. Her family members were well.

The patient was a nurse at an ophthalmology clinic who, during the previous two months, had often held children during irrigation of a lacrimal fistula. Physical examination showed no abnormal findings, while laboratory tests showed pancytopenia, WBC 1900/mm^3, hemoglobin 10.7 g/dl, and a platelet count of 138,000/mm^3. The patient's symptoms resolved within two days and she remained healthy for one week, but then developed low-grade fever and arthralgia with edema of the fingers and toes, and observed a lacy rash on her legs. While the rash disappeared within six days, she revisited our hospital for sustained arthralgia. Laboratory testing on this second visit showed WBC 5100/mm^3, hemoglobin 10.8 g/dl, and a platelet count of 259,000/mm^3. Serum testing found anti-parvovirus B19 IgM antibody. Two days after the second visit, the patient experienced facial erythema with edema, which resolved within the following four days. The arthralgia also resolved.

Discussion

To clarify the clinical findings of parvovirus B19 infection according to disease phase, we performed a retrospective chart review of 30 adult patients who tested positive for IgM antibody against the virus between March 2003 and November 2008. In more than 70% of our patients, onset of infection occurred in the outbreak, accounting for approximately 10% of the study period. Interestingly, its incidence in adults appeared to associate with that of erythema infectiosum. Our findings therefore suggest that parvovirus B19 infection in adults may be epidemic during an outbreak of erythema infectiosum.

A previous large-scale report regarding an outbreak of the virus in adults noted flu-like symptoms in 32 of 40 symptomatic individuals who had the IgM antibody [2]. Similarly, in the present study, fever was the most prominent symptom in the first phase of infection, and high fever was often accompanied by headache, myalgia, and malaise. The frequency of high fever, however, decreased from >60% in the first phase to <10% in the second phase. Various first-phase symptoms such as diarrhea, nausea, sore throat, conjunctivitis and pruritis were noted in our study, all of which are also known to occur in children with erythema infectiosum [9]. Gastrointestinal symptoms were observed in five of 30 patients (16.7%), all in the first phase, versus five of 40 adults (12.5%) in the previous study [2]. Accurate determination of the proportion of gastrointestinal or other symptoms with virus infection requires careful medical interview.

With respect to joint symptoms, our patients often complained of pain in the knees and small joints of the hands and foot, as previously reported [4–6]. On physical examination, the swelling of joints such as the PIP and MCP joints and knees was noted in three patients—observations similar to those made in a previous study [5]. Considering the involvement of small joints, this infection may be confused with rheumatoid arthritis, for which early diagnosis and therapy is required. With regard to the second phase of infection, while arthralgia was frequently reported (85.7%) by our patients, swelling of joints was less frequently observed on clinical examination (15.8%). Three patients had findings which are often involved in rheumatoid arthritis, namely symmetrical swelling in the PIP joints in two, in the metacarpal joints in two, and in the knees in one. However, a rash appeared simultaneously in all three patients with swollen joints, likely precluding the possibility of RA. Note that the co-occurrence of rash with arthralgia has been observed in 21.1–48.1% in previous large studies [4, 5, 7], albeit with less frequency than noted in the present study (19 of 24; 79.2%). Although RF was found in none of our patients, RF positivity has been noted in some cases [4, 5, 11]. Considering that our average patient visited the hospital complaining of arthralgia within one week and felt significant improvement within two weeks of onset, careful follow-up may be important in difficult cases, particulary during a parvovirus epidemic. Rash was frequently observed on the extremities (>90%), and less frequently on the face (<10%), the common site in erythema infectiosum, which was characteristic of the infection in adults. Lymphadenopathy was found in half of our patients, almost all of which was cervical. At this point it is worth noting our observation that, when present, lymphadenopathy occurred in both the first and second phases. A previous investigator also found that 6 of 11 patients had posterior cervical lymphadenopathy [6].

Analysis of laboratory test results showed that lymphopenia had a high frequency for parvovirus infection, at 75.9%, compared to leukopenia, neutropenia, anemia, and thrombocytopenia. Hypocomplementemia was present in half of our patients, all in the second phase, potentially indicating that rash and arthralgia was the result of immune complex disease.

One major limitation to our study warrants mention. The retrospective nature of our hospital-based study, which included only those patients positive for the IgM antibody against the virus, is subject to potential bias, especially in sex and age, as the Japanese health insurance system only covers antibody measurements in pregnant women. Although the present study is the largest to date, a more comprehensive understanding of the clinical findings of parvovirus infection will require a large prospective study.

In conclusion, parvovirus B19 infection in adults appears to be epidemic during an outbreak of erythema infectiosum. With regard to the disease phase, fever is frequent in the first phase, while rash or arthralgia is more common in the second. Female sex, age between 26 and 45, and presence of rash, arthralgia, fever, and lymphopenia were all found to be clinical findings with a high frequency for parvovirus infection, and may aid in the future diagnosis of parvovirus B19 infection.

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Conflict of interest None.

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