Shimane J. Med. Sci., Vol.30 pp.47-52, 2013

A Boy With Necrotizing Fasciitis Diagnosed at an Early Stage Using Magnetic Resonance Imaging

Naomi TANAKA[1) 2)], Noriaki MINAMI[2)], Yuichi MUSHIMOTO[2)], Rie KANAI[2)], Seiji YAMAGUCHI[2)], Tsuyoshi HIGUCHI[2)], Takumi KUWATA[1)] and Yuji UCHIO[1)]

[1)]*Department of Orthopaedic Surgery*

[2)]*Department Pediatrics, Shimane University School of Medicine*

（Received June 25, 2013; Accepted July 24, 2013）

An 18-month-old boy suffering from pain and swelling of the right leg and fever, all of which developed following chickenpox infection, was referred to our hospital. His peripheral blood white blood cell count and CRP were elevated to 19,630 /μl and 9.87 mg/dl, respectively. Streptococcal antigen was detected on the throat swab. T2-weighted magnetic resonance images demonstrated high intensity signal in the fascia on his right leg, suggesting a diagnosis of necrotizing fasciitis（NF）. Upon exploratory incision, surgical debridement and fasciotomy were performed on his leg. After surgery, pain and swelling of the leg and fever disappeared swiftly following antibiotics infusion. Two months postoperatively, he could walk without any impediment. Although NF is generally characterized by rapidly spreading necrosis and a high mortality rate, early diagnosis of NF with MRI followed by timely surgical intervention led to quick recovery of our patient without any major complications.

Key words: necrotizing fasciitis, child, magnetic resonance imaging, debridement, exploratory incision

INTRODUCTION

Necrotizing fasciitis（NF）is a soft tissue infection disease in which rapid spread of necrosis arising from the superficial layer of the fascia as the source occurs. NF in children is rare, and the prognosis is unfavorable if early treatment is not achieved［1］. Herein we report a boy with NF which was diagnosed at an early stage with combination of clinical findings and MRI, and was treated successfully.

CASE REPORT

An 18-month-old boy complained of swelling and pain of the right lower leg and fever. His clinical history included gastric torsiversion, but had no other abnormality during his growth and no notable findings in his family history.

Five days before consulting our institution, the patient was affected with chickenpox. He had never received chickenpox vaccine. One day before consulting our institution, he suffered from swelling and pain of the right lower leg and fever, and could not move the right lower leg smoothly. The next day, after consulting a pediatric clinic and orthopaedic clinic, he visited the pediatric department of a general hospital. Since NF was suspected based on his clinical symptoms and MRI findings, the patient was referred to our institution after receiving an anti-microbial agent（Sulbactam / Ampicillin, SBT/ABPC）.

At his first consultation at our institution, the boy had a body temperature of 38.5 °C, a pulse rate of 153 /min., a blood pressure of 128/78 mmHg, an arterial oxygen saturation（SpO_2）of 99%, and no tachypnea. Mild reddening of the tonsilla was seen, and the boy was bad-tempered. In his right lower leg, neither obvious reddening nor blister formation was seen, though tension and heat sensation were present（Fig. 1）. Autonomic movement of the right lower leg was weak, and the boy did not want to walk.

Upon admission, peripheral blood and biochemi-

Corresponding author: Naomi Tanaka, M.D.
Department of Orthopaedic Surgery, Shimane University School of Medicine, 89-1 Enya-cho, Izumo City, Shimane-Pref. 693-8501, Japan
Tel: +81-853-20-2242
Fax: +81-853-20-2236
E-mail: naomin@med.shimane-u.ac.jp

Fig. 1. Photograph of the legs at first consultation. There was no color tone change of the cuticula or blister formation. Tension feeling was present in the right lower leg. The circumference of the right and left legs were 21 cm and 19 cm, respectively.

cal examinations revealed increased white blood cell count (19,630 /μl) and C-reactive protein (CRP) level (9.87 mg/dl). No abnormalities were found in the coagulation / fibrinolytic system. There were no other notable findings except for an increased lactic dehydrogenase (LDH) level (Table 1). A plain CT image obtained at the previous hospital showed no notable gas (Fig. 2A). T2-weighted MR images showed high signal intensity in the fascia of the right lower leg, suggesting the presence of inflammation, and the inflammation extended to the soleus muscle and the femoral region (Figs. 2B and C).

TREATMENT COURSE AFTER ADMISSION

The patient was immediately admitted to our institution on the same day as being diagnosed with NF based on his clinical symptoms and MRI findings, and underwent emergent surgery under general anesthesia at 4 hours after admission. At exploratory incision, although notable necrotic tissues were seen, the fascia had stiff hypertrophy (Fig. 3). Incision of

Table 1. Laboratory findings on admission

Peripheral blood

White blood cell	19,630	/μl
Red blood cell	431 x 10^4	/μl
Hemoglobin	11.2	g/dl
Platelet	19.5 x 10^4	/μl
D dimer	2.5	ug/ml
Fibrinogen	483	mg/dl

Blood chemistry

Total protein	6.2	g/dl
Albumin	3.4	g/dl
AST (GOT)	27	IU/l
ALT (GPT)	17	IU/l
LDH	436	IU/l
Creatine kinase	92	IU/l
Amylase	40	IU/l
BUN	6.8	mg/dl
Creatinine	0.13	mg/dl
Glucose	110	mg/dl
Sodium (Na)	138	mEq/l
Potassium (K)	4.7	mEq/l
Chloride (Cl)	104	mEq/l
Calcium	9.4	mg/dl
C-reactive protein	9.87	mg/dl

Bacteriological examination

Rapid streptococcus hemolyticus infection	(+)
Nasopharyngeal mucus Streptococcus pyogenes	(++)
Wound irrigation water	(-)
Blood culture	(-)

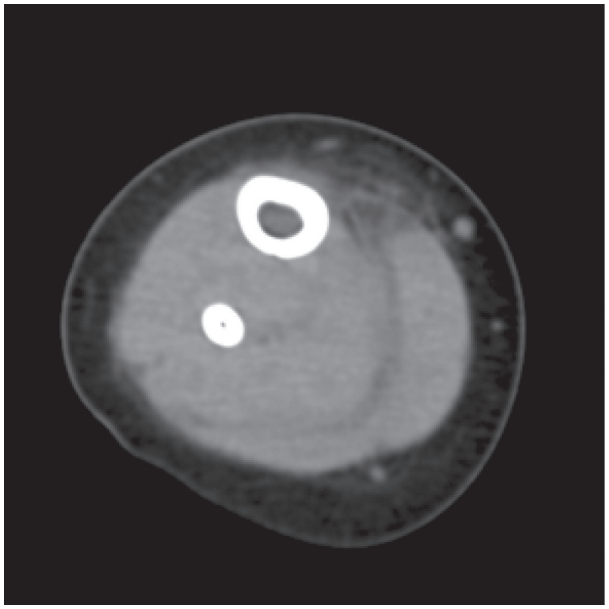

Fig. 2A. Axial plain CT image of the right lower leg. No obvious gas was seen.

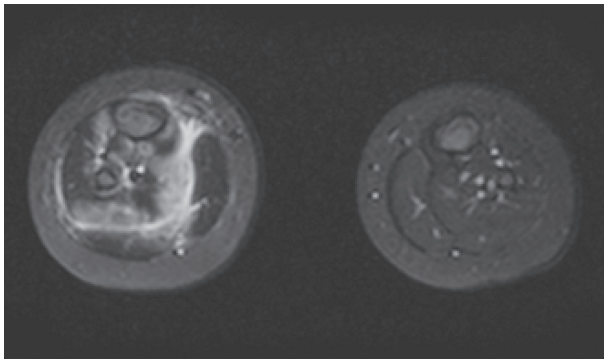

Fig. 2B. Axial T2-weighted fat-suppressed MR image of the lower legs. High signal intensity regions are seen in the gastrocnemial muscle and the fascia of soleus muscle of the right leg, suggesting inflammation.

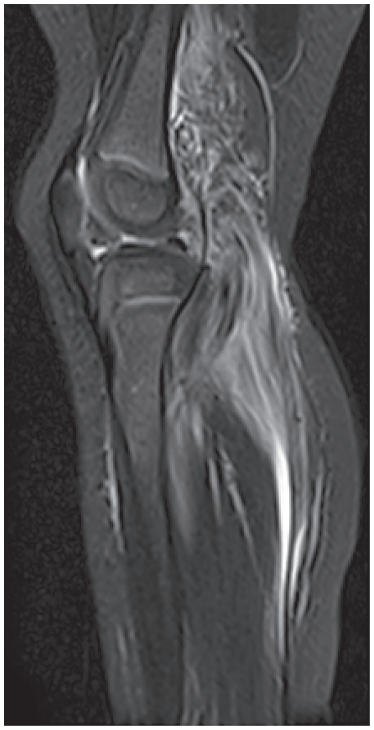

Fig. 2C. Sagittal T2-weighted fat-suppressed MR image of the right leg. High signal intensity extended from the lower leg to the femur, suggesting the presence of inflammation spreading towards the proximal region.

Fig. 3. At incision, a small amount of serous effusion fluid and thickening of the fascia were seen. The right and left sides of the photograph are distal and proximal side of the right leg, respectively.

the thickened fascia revealed swollen gastrocnemial muscle and soleus muscle. A small amount of serous effusion around the muscle was collected and was examined for bacterial culture; the intraoperative tissue culture examination showed a negative result. After surgical debridement of the muscle and intramuscular space with a sufficient amount of physiological saline water, the lesion was left as an open wound by just pulling the ends of the incision with silicone tape (Vessel Loop®, Aspen Surgical, MI, USA) (Fig. 4). Closure of the wound was scheduled for some days later, to allow confirmation of recovery.

After surgery, antimicrobial therapy was commenced with sulbactam-ampicillin (SBT/ABPC) 160mg/kg/day, clindamycin (CLDM) 40mg/kg/day, and immunoglobulin 250mg/kg/day. From the day after surgery, the pain in the right lower leg reduced, and the pains at rest and/or upon motion of the leg disappeared. From postoperative day (POD) 3,

Fig. 4. One day after surgical debridement. The wound, as well as the opened sore, was traction sutured (pulled) using a silicone tape (Vessel Loop®).

autonomic gait became possible. Administration of immunoglobulin and CLDM were suspended at POD 3 and 5, respectively, but SBT/ABPC was continued. The prognosis of the wound was favorable, and thus the wound was closed at POD 7. The patient was transferred to another hospital on POD 8, and was discharged from the hospital, walking by himself on POD 15. As of one year after surgery, the patient is in good condition without any fever, pain, or swelling of the right lower leg (Fig. 5).

DISCUSSION

There have been only a few reports of NF in Japan, though the incidence of NF among children in the USA is reported to range from 500 to 1,500 cases per year [1]. A major cause of NF in children is an association with chickenpox [2, 3, 4]. Eneli *et al*. reported 36 NF cases and stated that 81% of NF patients under the age of 5 years had at least one risk factor, and that the most frequent factor was chickenpox within one month before onset of NF in 46%, followed by other underlying diseases in 19% including Down's syndrome and congenital neutropenia [5].

It is presumed that the factors of increasing incidence of NF in patients suffering from chickenpox are deterioration of cutaneous barrier function and the associated reduction of resistance to bacterial infection [5]. Another potential factor is a relative reduction of humoral immunological function due to the activation of cellular immunity, mostly with type 1 helper T cells, induced from varicella-zoster virus (VZV) infection [5].

The interval between the onset of chickenpox and

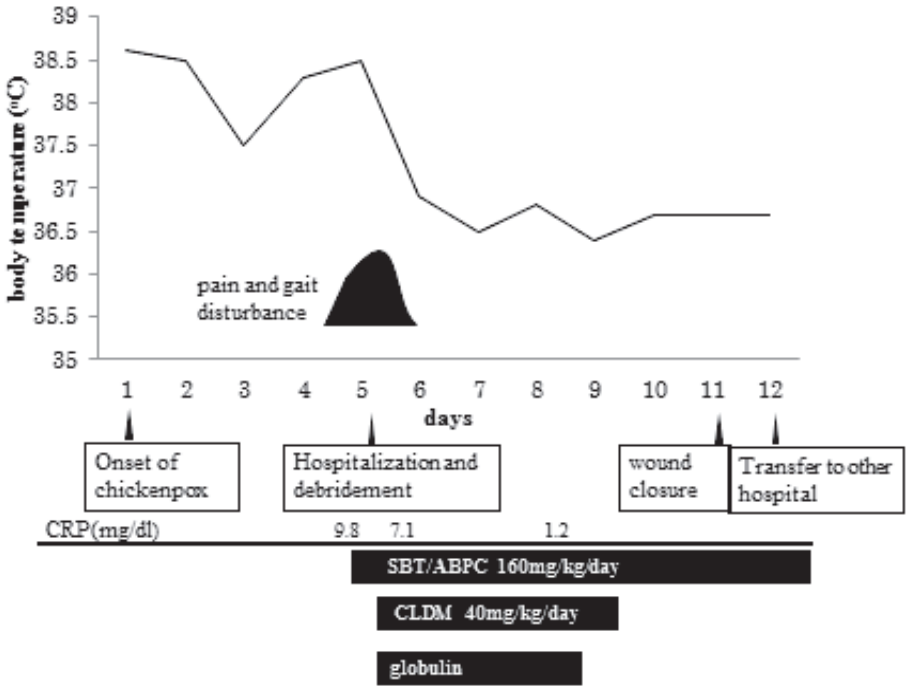

Fig. 5. Treatment course of the patient, defining the onset of chickenpox as Day 1. After the fever due to chickenpox reduced for a while, the fever increased again from Day 4, followed by pain in the right lower leg and gait disturbance. After surgical debridement, the fever reduced, and remission of the symptoms occurred promptly.

NF infection varies. Clark *et al*. reported an average of 5.2 days [4], Brogan *et al*. reported 3 days, and Waldhausen *et al*. reported 4 days [6, 7]. Our case presented NF 4 days after onset of chickenpox.

The most frequent etiologic bacteria of NF in children is known to be Group A hemolytic streptococcus (GAS) (*streptococcus pyogenes*) [5]. Etiologic bacteria other than GAS include *Staphylococcus aureus*. Clark *et al*. reported the prevalence of NF infection due to GAS in children under 5 years of age to be 2.12 patients / million population and that from other pathogens to be 0.81 patients / million population [4]. In our patient, both the blood culture in the previous hospital without antibiotics and intraoperative irrigated tissue culture examination at our institution were negative. Moss *et al*. showed that blood cultures were negative in 17 (85%) of 20 children with NF [3]. In contrast, Eneli *et al*. reported that blood cultures were negative in 21 (81%) of 26 children with GAS-related NF [5]. In the report, throat cultures were more available than blood cultures and positive in 8 (35%) of 23 children with GAS-related NF. Our case showed that antigen for *streptococcus hemolyticus* infection was positive by pharyngeal swab examination although blood cultures were negative. In addition, antibiotics (SBT/ABPC) might result in the negative of intraoperative irrigated tissue culture. There was scarce suspicion of other causative factors that was prevalent in the environment at that time or causative bacteria in his clinical history and clinical findings. Thus we considered the causative factor for our NF patient to be GAS, as reported by other researchers.

We believe that aggressive treatment of NF patients should be performed immediately without hesitation upon evaluation of their general condition. There have been reports of deaths even when bacterial examination results were negative. These included one of 5 NF cases after onset of chickenpox with negative bacterial examination [4], and 3 of 13 child NF cases showing no presence of causal bacteria in either peripheral blood or tissues by bacterial examination - one of the 3 died [2].

Blood tests and imaging findings are the major tools for diagnosis of NF, especially in children, but they are not definitive, and differentiation between NF and cellulitis (honeycomb pattern inflammation) or pyomyositis is difficult. Moss *et al*. reported that 20 child NF cases which presented only edema on physical findings but no necrosis or blister [3]. However, delay of NF diagnosis can be lethal. Moss *et al*. reported the survival rate was 100% in cases where surgical debridement was performed within 3 hours of admission, but lives could not be saved when surgical debridement was done at 18 hours or 24 hours after admission [3]. Deniel A *et al*. reported mortality of 100% in cases where debridement was not performed after diagnosis of NF [1].

The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score, that was demonstrated by Wong *et al*. in 2004, predicts the prognosis of NF based on CRP, white blood cell count, hemoglobin, sodium, creatine, and blood glucose level (Table 2) [8]. According to this evaluation method, our case scored 2 points, suggesting a low risk and less than 50% probability of NF. However, our diagnosis of NF based on physical findings and MR imaging

Table 2. Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) Score

Values	Points	Our Case
C-reactive protein (mg/L)		
< 150	0	0
≧150	4	
WBC count (cell/mm^3)		
< 15	0	
15-25	1	1
> 25	2	
Hemoglobin level (g/dl)		
> 13.5	0	
11-13.5	1	1
<11	2	
Sodium level (mmol/l)		
≧135	0	0
< 135	2	
Creatinine level (mg/dl)		
≦1.6	0	0
> 1.6	2	
Glucose level (mg/dl)		
≦180	0	0
> 180	1	

findings led to a successful treatment outcome after surgical debridement at the early stage of the disease. Even when the LRINEC score is low, if NF is suspected, aggressive surgical debridement is recommended as early as possible.

CONCLUSION

Our 18-month-old male patient was diagnosed with NF at the early stage of disease using MRI and clinical findings, and the causal factor was considered GAS infection after chickenpox. A favorable treatment outcome was achieved after surgical debridement upon admission immediately following diagnosis.

REFERENCES

1）Anaya DA and Dellinger EP（2007）Necrotizing soft-tissue infection: diagnosis and management. *Clin Infect Dis.* Mar 1; 44（5）: 705-10.
2）Bingöl-Koloğlu M, Yildiz RV, Alper B, Yağmurlu A, Ciftçi E, Gökçora IH, Ince E, Emiroğlu M and Dindar H（2007）Necrotizing fasciitis in children: diagnostic and therapeutic aspects. *J Pediatr Surg.* Nov; 42（11）: 1892-7.
3）Moss RL, Musemeche CA and Kosloske AM（1996）Necrotizing fasciitis in children: Prompt recognition and aggressive therapy improve survival. *J Pediatr Surg.* Aug; 31（8）: 1142-6.
4）Clark P, Davidson D, Lawton L and Jawadi A（2003）Necrotizing fasciitis secondary to chickenpox infection in children. *Can J Surg.* Feb; 46（1）: 9-14
5）Eneli I and Davies HD（2007）Epidemiology and outcome of necrotizing fasciitis in children: An active surveillance study of the Canadian Paediatric Surveillance Program. *J Pediatr.* Jul; 151（1）: 79-84, 84. e1.
6）Brogan TV, Nizet V, Waldhausen JH, Rubens CE and Clarke WR（1995）Group A streptococcal necrotizing fasciitis complicating primary varicella: a series of fourteen patients. *Pediatr Infect Dis J.* Jul; 14（7）: 588-94.
7）Waldhausen JH, Holterman MJ and Sawin RS（1996）Surgical implications of necrotizing fasciitis in children with chickenpox. *J Pediatr Surg.* Aug; 31（8）: 1138-41.
8）Wong CH, Khin LW, Heng KS, Tan KC and Low CO.（2004）The LRINEC（Laboratory Risk Indicator for Necrotizing Fasciitis）score: a tool for distinguish necrotizing fasciitis from other soft tissue infections. *Crit Care Med.* Jul; 32（7）: 1535-41.
9）Salvador VB, San Juan MD, Salisi JA and Consunji RJ（2010）Clinical and microbiological spectrum of necrotizing fasciitis in surgical patients at a Philippine university medical center. *Asian J Surg.* Jan; 33（1）: 51-8.
10）Murphy JJ, Granger R, Blair GK, Miller GG, Fraser GC and Magee JF（1995）Necrotizing fasciitis in childhood. *J Pediatr Surg.* Aug; 30（8）: 1131-4.