Infective Endocarditis Associated with Atopic Dermatitis

Report of a Case and Review of Reported Cases

Shigeaki Aoyagi,¹ MD, Takeshi Oda,¹ MD, Kumiko Wada,¹ MD, Eiji Nakamura,¹ MD,
Tomokazu Kosuga,¹ MD and Hiroshi Yasunaga,¹ MD

Summary

We report a case of aortic valve infective endocarditis (IE) in a 24-year-old man with atopic dermatitis (AD). He had a history of balloon valvuloplasty for a stenotic bicuspid aortic valve, and had dental caries but no invasive dental procedure before the onset of IE. On admission, skin lesions of AD with itching and scratches were found on the neck, trunk, and extremities. Echocardiography showed a vegetation on the aortic valve with mild steno-regurgitation, but extension of IE to the annulus was not detected. Magnetic resonance imaging identified fresh cerebral infarction without neurological dysfunction, leading us to suspect an embolism. Blood cultures grew methicillin-sensitive *Staphylococcus aureus*. During emergency surgery, a vegetation attached to the conjoined cusp was observed, and the aortic valve was replaced with a mechanical valve. The patient recovered uneventfully without any complications such as recurrent IE or mediastinitis. We also review previously reported cases of IE associated with AD.

(Int Heart J 2018; 59: 420-423)

Key words: Embolism, Skin lesion colonization, *Staphylococcus aureus*, Stroke, Valve disease

Infective endocarditis (IE) is a typically lethal disease, and early diagnosis and prompt treatment are crucial for preventing serious complications and death. Atopic dermatitis (AD) is a chronic, relapsing eczematous skin disease characterized by pruritus and inflammation. In AD skin lesions, colonization by *Staphylococcus* (*S.*) *aureus* is common, therefore, scratching of the pruritic lesions may lead to repeated bacteremia and endocarditis.¹⁻³⁾

In this paper, we report a case of aortic valve IE in a patient with AD, and review previously reported cases.

Case Report

A 24-year-old man was emergently transferred to our hospital due to hypotension after suffering for 3 days from a high fever. He had dental caries but he denied any dental procedure before the onset of this condition. He had a history of balloon valvuloplasty for a stenotic bicuspid aortic valve at the ages of 3 and 6, and he had suffered from AD since childhood, however, he always refused topical steroid treatment and used a moisturizer for the AD skin lesions. On admission, he was confused, and had a blood pressure of 78/48 mmHg and a pulse rate of 120/minute. His skin was dry, and longstanding skin eruptions, multiple eczematous lesions, chronic papules and lichenifications, with itching and scratches were found on the neck, trunk, and extremities (Figure A). Auscultation revealed a systolic ejection murmur in the aortic area. No neurological dysfunction was observed. Laboratory inves-

tigations showed hemoglobin 13.7 g/dL, white cell count 11,340/mm³, and C-reactive protein (CRP) 10.2 mg/dL. A chest X-ray revealed a normal cardiac silhouette without pulmonary congestion. After two sets of blood cultures were taken, antibiotic therapy with ceftriaxone (2 g/day) was empirically started, and tacrolimus ointment was added to a moisturizer (heparinoid preparation) for the skin lesions because the patient did not consent to topical steroid therapy. In addition to mild mitral regurgitation, transthoracic echocardiography (TTE) revealed a normal-sized left ventricle and a bicuspid aortic valve with mild steno-regurgitation (a peak pressure gradient of 53 mmHg, valve area of 1.8 cm², and mild regurgitation). However, no vegetation was detected on TTE. When blood cultures were positive for methicillin-sensitive *S. aureus* 2 days after this admission, antibiotic therapy with gentamicin (180 mg/day) and cefazolin (8 g/day) was immediately begun. Transesophageal echocardiography demonstrated a mobile vegetation (1.0 × 1.0 cm in size) attached to the aortic valve (Figures B, C) and confirmed the findings obtained by TTE. Although brain computed tomography (CT) showed no abnormality, magnetic resonance imaging identified areas with a high-intensity signal in the left temporal lobe suggestive of embolisms. His inflammatory signs were temporarily improved by the antibiotic therapy, however, 2 days later, severe anterior chest pain with further elevation of CRP (19.7 mg/dL) and a sustained high fever developed. CT showed the presence of a moderate amount of pleural and pericardial effusion, suggesting acute

From the ¹Department of Cardiovascular Surgery, St. Mary's Hospital, Kurume, Japan.

Address for correspondence: Shigeaki Aoyagi, MD, Department of Cardiovascular Surgery, St. Mary's Hospital, 422 Tsubukuhon-machi, Kurume 830-8543, Japan. E-mail: shigeakiaoyagi@gmail.com

Received for publication February 9, 2017. Revised and accepted June 9, 2017.

Released in advance online on J-STAGE March 20, 2018.

doi: 10.1536/ihj.17-078

All rights reserved by the International Heart Journal Association.

Figure. A: Photograph showing dry skin and atopic skin lesions such as chronic papules and lichenifications with scratches on the lower extremities. B and C: Transesophageal echocardiograph (B: long-axis, C: short-axis) showing a vegetation (arrows) attached to the bicuspid aortic valve. D: Operative photograph showing a vegetation (arrows) attached to the aortic valve. Ao indicates aorta; LA, left atrium; LV, left ventricle; and RV, right ventricle.

pleuro-pericarditis. Because of uncontrolled infection (extracardiac spread of acute inflammation) despite the adequate antibiotic therapy, emergent valve surgery was performed through a median sternotomy.⁴⁾ After evacuation of the non-suppurative pericardial effusions, the aortic valve was approached under cardiopulmonary bypass and cardioplegic cardiac arrest. The aortic valve was bicuspid, and the vegetation (1.5 cm in maximal length) was attached to the conjoined cusp without destruction of the annulus (Figure D). Aortic valve replacement was performed with a mechanical valve. Postoperatively, antibiotic therapy with gentamicin (180 mg/day) and cefazolin (8 g/day) was maintained for 5 weeks until the inflammatory signs had disappeared. Pathologic examination of the vegetation demonstrated infiltrations of inflammatory cells and bacterial foci. A small number of *S. capitis* was cultured from his skin lesions with enrichment culture performed 3 weeks after the operation. The patient is doing well without recurrence of IE at 2 years after surgery under anticoagulant therapy with warfarin and dermatological management for AD.

Discussion

Atopic dermatitis (AD) is one of the most common skin diseases and affects 1-3% of the population.⁵⁾ Coloni-

zation by *S. aureus* is observed in the skin lesions in more than 90% of patients with AD due to a deficiency in the expression of inflammation-induced antimicrobial, antifungal, and antiviral peptides, therefore, scratching of the pruritic skin lesions may easily lead to invasive *S. aureus* infections such as bacteremia and endocarditis.^{2,3,6)} Although direct evidence showing a causative relationship between skin lesions in AD and IE is scarce, Yamamoto, *et al*⁷⁾ confirmed identity between blood culture and skin isolates in a patient with AD who had repeated prosthetic valve endocarditis caused by *S. aureus*. A culture sample from the skin lesions was not taken in our patient, preoperatively, however, the AD skin lesions were considered to be the source of IE because no alternative and more likely cause was identified, and because of the presence of pruritic skin lesions with breached skin. Postoperatively, a small number of *S. capitis*, not *S. aureus*, was isolated from the skin lesions with enrichment culture. This may have resulted from the preoperative and postoperative administration of antibiotics effective against *S. aureus*. It has been confirmed that the density of *S. aureus* in atopic skin lesions is significantly reduced to a harmless level after one week of appropriate antibiotic therapy.¹⁾

A nationwide survey of the current clinical characteristics of IE in Japan indicated that the number of IE patients with AD increased from 5 (0.6%) of 848 cases in

Table. Reported IE Patients Related to Atopic Dermatitis

Case	Age/ Sex	Heart disease Predisposing factor	Blood culture	Emboic event	Valve involved	Treatment/ Complication	Reference
1	3.5/M	VSD, immunodeficiency	<i>S. aureus</i>	-	tricuspid	vegetectomy	13)
2	24/M	complex CHD, steroid	<i>S. aureus</i>	-	-	antibiotics	14)
3	33/M	no	<i>S. aureus</i>	Janeway lesions	aortic	AVR+PM Implant	15)
4	18/M	no	<i>S. aureus</i>	-	mitral	MVR	5)
5	45/M	MV prolapse	<i>S. aureus</i>	peripheral	mitral	MVR	5)
6	16/M	no	<i>S. aureus</i>	-	aortic	AVR/IE of MV, mediastinitis	16)
7	14/M	no	<i>S. aureus</i>	-	mitral	MVP	16)
8	50/F	no, immunosuppressant	<i>S. aureus</i>	-	mitral	MVP	17)
9	36/F	no	<i>S. aureus</i>	peripheral	mitral	MVR	2)
10	27/M	MVR for IE	<i>S. aureus</i>	-	mitral (PVE)	3rd MVR/ recurrent PVE	7)
11	30/M	no, steroid	<i>S. aureus</i>	cerebral, peripheral	mitral	MVR	3)
12	15/M	no, acupuncture	<i>S. aureus</i>	pulmonary	tricuspid	antibiotics	18)
13	20/M	MR	<i>S. aureus</i>	cerebral	mitral	MVP/mediastinitis	9)
14	20/F	TR	<i>S. aureus</i>	pulmonary	tricuspid	TVP	9)
15	37/M	MR	<i>S. aureus</i>	cerebral, renal, splenic	mitral	MVP	9)
16	31/M	MR	<i>S. aureus</i>	cerebral	mitral	MVP	9)
17	40/M	MR+ASD	<i>S. aureus</i>	cerebral	mitral	MVP+ASD closure	9)
18	21/F	MR	<i>Strep. viridans</i>	no	mitral	MVP	9)
19	28/M	MR	<i>S. aureus</i>	cerebral, renal, splenic	mitral	MVP	9)
20	30/M	AR+MR	<i>S. aureus</i>	cerebral	aortic+mitral	AVR+MVP	9)
21	34/F	no	<i>S. aureus</i>	pulmonary	tricuspid+RSV	TVR+RSV closure	19)
22	17/F	-	<i>S. aureus</i>	cerebral	mitral	MVR	20)
23	39/M	no, steroid	<i>S. aureus</i>	no	mitral	MVP+PFO closure	21)
24	24/M	BAV, Asr (post BVP)	<i>S. aureus</i>	cerebral	aortic	AVR	Present case

AR indicates aortic regurgitation; ASD, atrial septal defect; Asr, aortic steno-regurgitation; AVR, aortic valve replacement; BAV, bicuspid aortic valve; BVP, balloon valvuloplasty; CHD, congenital heart disease; IE, infective endocarditis; MR, mitral regurgitation; MV, mitral valve; MVP, mitral valve plasty; MVR, mitral valve replacement; PM, pacemaker; PVE, prosthetic valve endocarditis; RSV, ruptured aneurysm of the sinus of Valsalva; *S.*, staphylococcus; *Strept.*, streptococcus; TR, tricuspid regurgitation; TVP, tricuspid valve plasty; TVR, tricuspid valve replacement; VSD, ventricular septal defect; M, male; and F, female.

2000-2001 to 5 (1.2%) of 513 cases in 2007-2009.⁸⁾ In 2013, Fukunaga, *et al*⁹⁾ reported 8 patients with AD among 120 IE patients between 1997 and 2010, yielding an incidence rate of 6.7%. To the best of our knowledge, only 23 patients have been previously described in the English literature, excluding proceedings for oral presentations and case reports on the same patients (Table), by the end of 2016. A review of these 24 patients, including the present patient, demonstrated several characteristic features of IE related to AD. Nowadays, IE increasingly tends to be observed in older patients, however, IE related to AD develops in young patients. The median age of the 24 patients was 27.5 years, which is very young compared with that of IE patients in the general population.¹⁰⁾ An extremely high prevalence of *S. aureus* as the causative organism of IE associated with AD is the other characteristic feature. *S. aureus* was found in approximately 30-35% of IE.³⁾ However, in the 24 patients with AD, *S. aureus* was the causative organism in all except one patient with *Streptococcus viridans*. This fact supports the suggestion that the skin is the portal of entry of *S. aureus* to the bloodstream.²⁾ Another clinical characteristic of the IE patients with AD is a very high incidence of embolic events. Among the 24 patients, 15 (62.5%) developed a variety of embolic events, in particular, 8 (53.3%) of the 15 patients suffered from cerebral embolisms.

Infection resistant to antibiotic therapy required ur-

gent valve surgery in our patient. Fortunately, postoperative complications such as recurrent infection and mediastinitis did not develop despite the urgent surgery. Fukunaga, *et al*¹¹⁾ previously reported a high incidence of 15% for postoperative mediastinitis in 20 patients with AD who underwent cardiovascular surgery through a median sternotomy, and have emphasized the advantages of a thoracotomy for preventing postoperative mediastinitis. In our review of the 24 patients with AD, 2 (10.5%) of 19 patients who underwent valve surgery through a median sternotomy developed postoperative mediastinitis. Selection of thoracotomy as a surgical approach may be a favorable optional strategy for valve surgery in patients with AD. In addition, Fukunaga, *et al*⁹⁾ have stressed that pre-operative skin care for AD by dermatologists is also important for preventing postoperative infection. According to the guidelines for AD management, skin care for dry skin or slight skin eruption is recommended to prevent the recurrence of inflammation and reduce symptoms.¹²⁾ Considering the high density of *S. aureus* on skin lesions in AD and the decreased barrier function in AD skin,⁴⁾ long-term dermatological management to control skin lesions is essential for all patients with AD to prevent infection with *S. aureus*, regardless of the need for cardiac surgery.

In conclusion, we report a case of active IE in a young patient with AD who had a bicuspid aortic valve. Although the incidence of IE in patients with AD is not

very frequent, it is important for dermatologists, cardiologists, and cardiac surgeons to recognize that there has been a marked increase in IE related to AD and to understand the pathologic relationship between AD and IE.

Disclosures

Conflicts of interest: The authors declare that we have no conflicts of interest to report.

References

1. Leyden JJ, Marples RR, Kligman AM. Staphylococcus aureus in the lesions of atopic dermatitis. *Br J Dermatol* 1974; 90: 525-30.
2. Benenson S, Zimhony O, Dahan D, *et al.* Atopic dermatitis—a risk factor for invasive Staphylococcus aureus infections: two cases and review. *Am J Med* 2005; 118: 1048-51. (Review)
3. Mohiyiddeen G, Brett I, Jude E. Infective endocarditis caused by Staphylococcus aureus in a patient with atopic dermatitis: a case report. *J Med Case Rep* 2008; 2: 143.
4. Chen J, Lu S, Hu K, *et al.* Clinical characteristics and surgical treatment of infective endocarditis with bicuspid aortic valve. *Int Heart J* 2017; 58: 220-4.
5. Conway DS, Taylor AD, Burrell CJ. Atopic eczema and staphylococcal endocarditis: time to recognize an association? *Hosp Med* 2000; 61: 356-7.
6. Ong PY, Ohtake T, Brandt C, *et al.* Endogenous antimicrobial peptides and skin infections in atopic dermatitis. *N Engl J Med* 2002; 347: 1151-60.
7. Yamamoto T, Yodogawa K, Wakita S, *et al.* Recurrent prosthetic valve endocarditis caused by Staphylococcus aureus colonizing skin lesions in severe atopic dermatitis. *Intern Med* 2007; 46: 571-3. (Review)
8. Nakatani S, Mitsutake K, Ohara T, Kokubo Y, Yamamoto H, Hanai S. Recent picture of infective endocarditis in Japan—lessons from Cardiac Disease Registration (CADRE-IE). *Circ J* 2013; 77: 1558-64.
9. Fukunaga N, Okada Y, Konishi Y, Murashita T, Koyama T. Pay attention to valvular disease in the presence of atopic dermatitis. *Circ J* 2013; 77: 1862-6.
10. Selton-Suty C, Celard M, Le Moing V, *et al.* Preeminence of Staphylococcus aureus in infective endocarditis: a 1-year population-based survey. *Clin Infect Dis* 2012; 54: 1230-9.
11. Fukunaga N, Yuzaki M, Shomura Y, Fujiwara H, Nasu M, Okada Y. Clinical outcomes of open heart surgery in patients with atopic dermatitis. *Asian Cardiovasc Thorac Ann* 2011; 20: 137-40.
12. Saeki H, Furue M, Furukawa F, *et al.* Guidelines for management of atopic dermatitis. *J Dermatol* 2009; 36: 563-77.
13. Pike MG, Warner JO. Atopic dermatitis complicated by acute bacterial endocarditis. *Acta Paediatr Scand* 1989; 78: 463-4.
14. Grabczynska SA, Cerio R. Infective endocarditis associated with atopic eczema. *Br J Dermatol* 1999; 140: 1193-4. (Review)
15. Kobayashi H, Sugiuchi R, Tabata N, *et al.* Guess what! Acute infectious endocarditis with Janeway lesions in a patient with atopic dermatitis. *Eur J Dermatol* 1999; 9: 239-40.
16. Onoda K, Mizutan H, Komada T, *et al.* Atopic dermatitis as a risk factor for acute native valve endocarditis. *J Heart Valve Dis* 2000; 9: 469-71.
17. Satchell AC, Barnetson RS. Staphylococcal septicaemia complicating treatment of atopic dermatitis with mycophenolate. *Br J Dermatol* 2000; 143: 202-3.
18. Buckley DA. Staphylococcus aureus endocarditis as a complication of acupuncture for eczema. *Br J Dermatol* 2011; 164: 1405-6.
19. Horimoto K, Kubo T, Matsusaka H, Baba H, Umesue M. Right-sided infective endocarditis with a ruptured sinus of Valsalva and multiple septic pulmonary emboli in a patient with atopic dermatitis. *Intern Med* 2015; 54: 797-800.
20. Patel D, Jahnke MN. Serious Complications from Staphylococcal aureus in atopic dermatitis. *Pediatr Dermatol* 2015; 32: 792-6. (Review)
21. Micallef MJ, Ramphul A. Infective endocarditis in a patient with atopic dermatitis. *J Cardiol Cases* 2016; 13: 153-4.