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CASE STUDY

Cutaneous arteritis with compartment syndrome: Case report and review of published works

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Abstract

Cutaneous arteritis (CA) is a rare limited form of polyarteritis nodosa (PAN), which usually has a benign prognosis and requires less aggressive therapy. Here, we present a case of CA localized to both skin and muscle limited to the same area as skin lesions. We propose CA with muscle disorders as a severe subtype of CA and present a literature review of CA with muscle disorders, which may require treatment with intravenous pulse methylprednisolone, immunosuppressive therapy, and below-the-knee amputation. Our case presented here demonstrates a severe case of CA associated with compartment syndrome, leading to a highly elevated serum concentration of procalcitonin.

KEYWORDS
compartment syndrome, cutaneous arteritis, cutaneous polyarteritis nodosa, muscular polyarteritis nodosa, procalcitonin

1 | INTRODUCTION

Polyarteritis nodosa (PAN) refers to systemic necrotizing arteritis of small- to medium-sized muscular arteries. Cutaneous PAN is often referred to as Cutaneous arteritis (CA) since 2012, and CA is assumed to affect only the skin, but CA is occasionally associated with neuropathy and muscular disorders.[1–3] Here, we report a case of CA with muscle disorders accompanied by skin lesions on the limbs and muscular damage in the right lower limb, along with a review of the relevant literature.

2 | CASE REPORT

A 76-year-old Japanese man developed joint pain in all limbs and general fatigue about 1 month before his initial consultation to our department. On initial examination, the patient was lucid, his temperature was elevated to 37.9°C, his SpO_2 was 96% (room air), his blood pressure was 106/69 mmHg, and he showed tachycardia (heart rate 120 bpm). Blood analysis showed an elevated white blood cell count (26,100/μl; reference: 3900–9800), C-reactive protein (CRP) level (42.36 mg/dl; reference: 0–0.2), procalcitonin (PCT) level (50.910 ng/ml; reference: <0.5), and creatinine kinase (CK) level (4271 IU/L; reference: 45–226). The bilateral lower limbs exhibited redness, swelling, warmth, and purpura, which were significant on the right side. Furthermore, purpura with red halos was observed on the fingers, toes, and dorsum of the foot (Figure 1A,B). Contrast-enhanced computed tomography (CT) revealed no significant findings in the thoracoabdominal region but showed swelling of the right leg extensor muscle group, slight fluid retention between the superficial posterior and deep posterior compartments, and an elevated subcutaneous fatty tissue concentration (Figure 1C). However, no clear gas, abscess, intra-arterial thrombi or contrast enhancement of branching vessels were observed. Severe tension was observed in the right lower limb. The internal pressures of the right lower limb compartments were measured. The pressure of the anterior compartment was 40 mmHg and that of the superficial

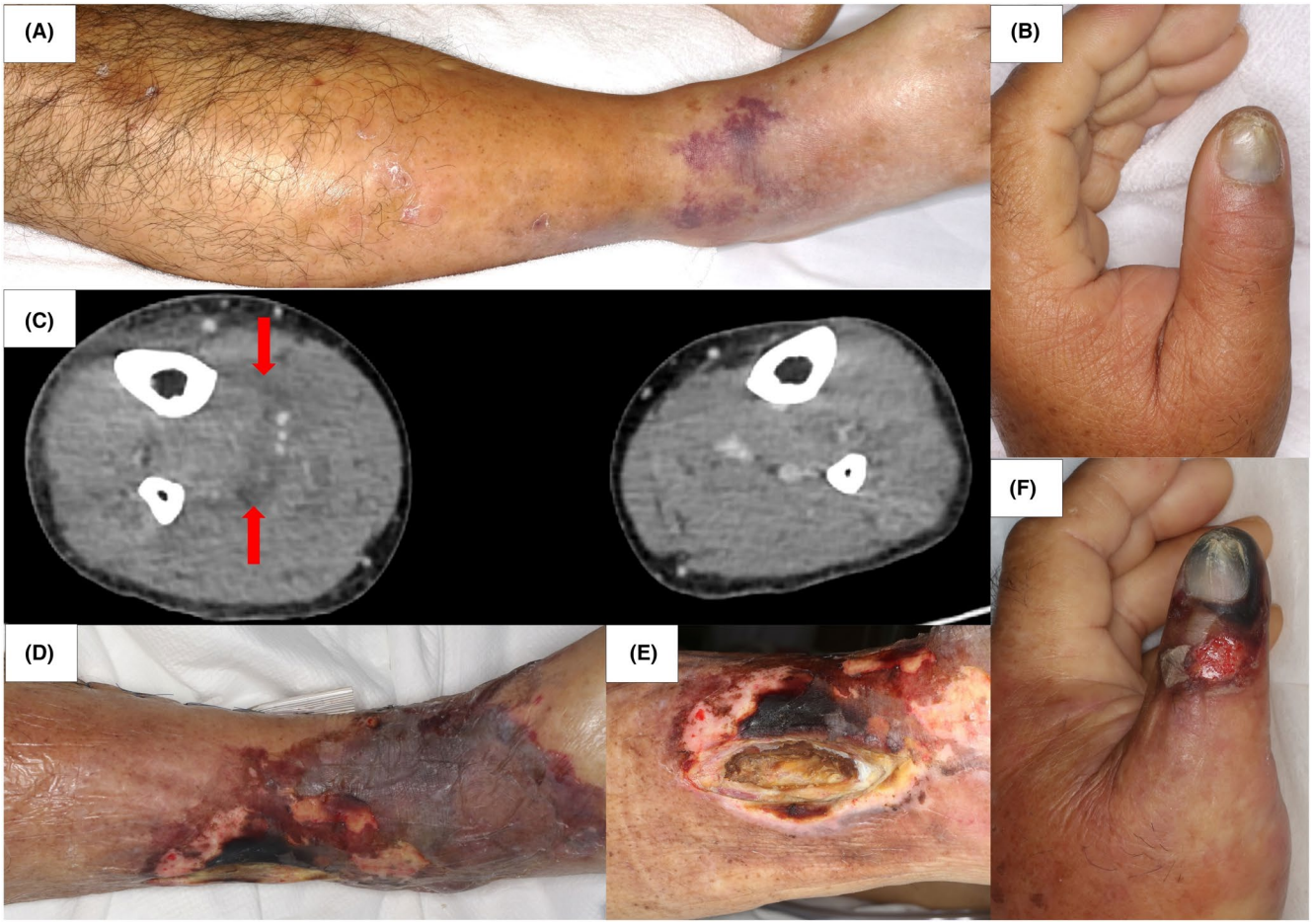

FIGURE 1 Photographs of the right lower extremity (A) and left hand (B) on the day of admission. There was painful erythema with purpura and severe edema. Contrast-enhanced computed tomography (CT) revealed no fascial thickening and no soft tissue gas. Swelling of the right leg extensor muscle group, slight fluid retention between the superficial posterior and deep posterior compartments (arrow), and an elevated subcutaneous fatty tissue level (C), were evident. Photographs of the right lower extremity (D, E) and left hand (F) on the day of methylprednisolone (Sol-Melcort®) 1000 mg administration. There was extensive erythema, purpura, ulcer, and muscle necrosis [Color figure can be viewed at wileyonlinelibrary.com]

posterior compartment was 37 mmHg; values >30 mmHg are considered abnormally high. Based on these findings, we made a diagnosis of right lower limb compartment syndrome and suspected necrotizing fasciitis. Under general anesthesia, a skin incision and fasciotomy of the right lower limb were performed, and various bacteriological cultures were submitted for testing. The intraoperative findings showed mild muscular necrosis but no clear necrosis of the fascia, thus excluding necrotizing fasciitis. After making the incision, hypotension was observed, so systemic management was performed under artificial respiration after hospital admission. An intravenous drip infusion of meropenem hydrate (Meropenem®) was commenced because soft tissue infection and sepsis were given priority. On day 3 of hospitalization, blood biochemical tests revealed a persistently elevated CRP level (37.60 mg/dl). The incision site on the lateral side of the right lower limb developed ulcers, resulting in necrosis of the right leg extensor muscle group. Furthermore, respiratory failure set in and high fever and hypotension persisted, indicating septic shock. Despite massive transfusion with catecholamine therapy and 200 mg of hydrocortisone (Sol-Cortef®), no clear improvement was observed. On day 5 of hospitalization, the results of the blood cultures submitted at the initial examination and culture test of tissue sampled at the time of fasciotomy were found to be negative. Therefore, the possibility of systemic vasculitis or vasculitis associated with connective tissue diseases was considered, and skin biopsies of the new purpura on the foot dorsum were performed. Histopathological examination revealed thrombi and fibrinoid degeneration of medium-sized arterioles of subcutaneous adipose tissue and infiltration of inflammatory cells (e.g., neutrophils) into the vascular walls, finally confirming the diagnosis of necrotizing angiitis. Histopathological examination of the tibialis anterior muscle showed muscle degeneration with neutrophil and lymphocyte infiltration (Figure 2A–D). These findings confirmed the diagnosis of CA with compartment syndrome without visceral involvement. From day 15 of hospitalization, methylprednisolone (Sol-Melcort®) was administered at 1000 mg for 3 days, after which high-dose steroid therapy was administered (Figure 1D–F). On day 16 of hospitalization, the patient showed improved respiratory function and was removed from the artificial respirator. No enlargement of the ulcer was observed, the high fever and hypotension had improved, and the CRP and PCT levels had

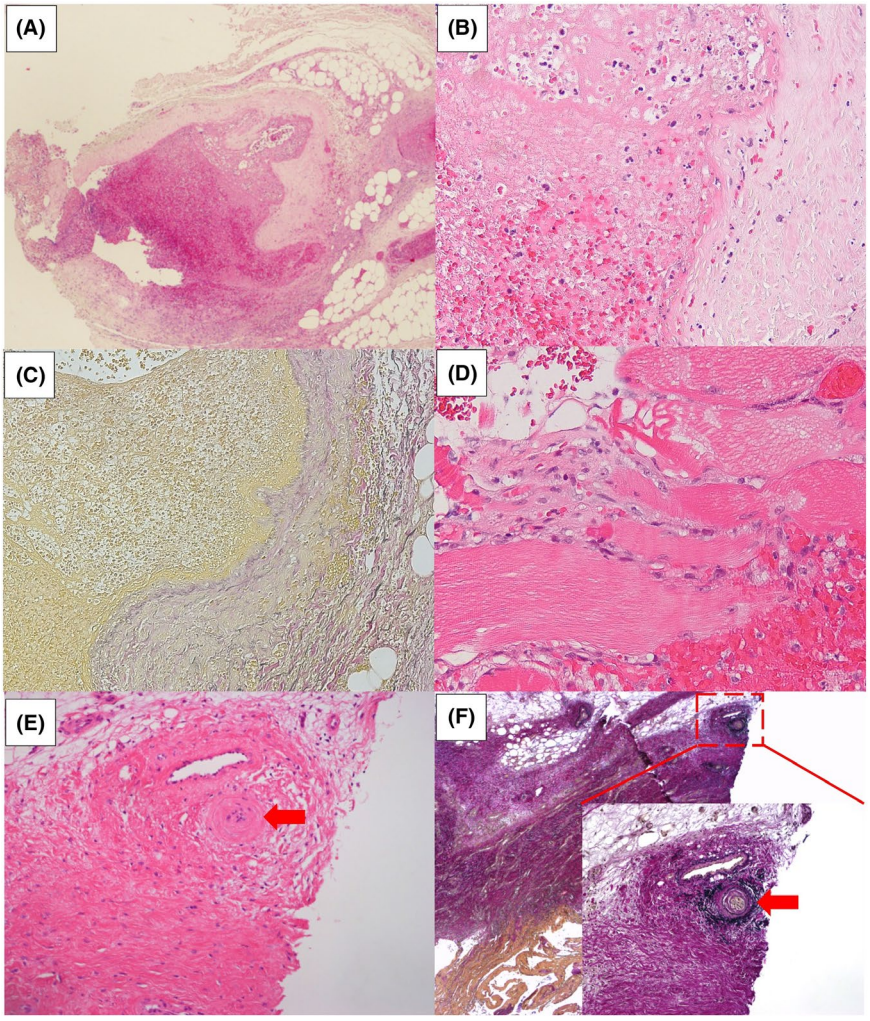

FIGURE 2 (A-C) Histopathologically, there was necrotizing vasculitis in medium-sized arterioles of subcutaneous adipose tissue. Vasculitis ruptured internal and external elastic membrane. (D) There was muscle degeneration with infiltration of neutrophils and lymphocytes. (E, F) There was fibrosis above the muscle surrounding the arteries, the elastic lamina of which had degenerated with a scar occluding the lumen, in the amputated lower limb. (A-B, D-E: Hematoxylin-and-eosin staining. C, F: Elastica-van-Gieson staining. A: ×20, B-E: ×200, F: ×20 and ×200) [Color figure can be viewed at wileyonlinelibrary.com]

decreased. Thereafter, additional oral azathioprine was administered, and the prednisolone dose was gradually reduced. However, below-the-knee amputation was performed 4 months after hospitalization because of the high risk of infection caused by the extensive muscular necrosis of the lower limb. Histopathological examination of amputated lower limb showed fibrosis above the muscle surrounding the arteries, the elastic lamina of which had degenerated with a scar occluding the lumen (Figure 2E,F). While receiving oral therapy with 17.5 mg of prednisolone and 75 mg of azathioprine, at 3 months after amputation, he developed new purpura on the upper limbs. The skin of the purpuric region was biopsied, and necrotizing vasculitis in the small arteries of the adipose tissue was observed. Therefore, an intravenous drip infusion of cyclophosphamide hydrate was administered, but the symptoms were limited to the skin. At 6 months after amputation, the purpura had disappeared and the patient is currently being followed with no relapse.

3 | DISCUSSION

Purpura, subcutaneous nodules, livedo, and ulcers are characteristic cutaneous features of CA.[1,2] Whether CA exists on a spectrum with systemic PAN is controversial. CA is assumed to have a benign prognosis and require less intensive immunosuppressive therapy. Muscular polyarteritis nodosa (MPAN) is a concept proposed by Kamimura in which muscle can be a single affected site, and the paucity of systemic involvement is emphasized.[4] MPAN cases frequently exhibit symptoms such as muscular pain and swelling in the lower limbs, including the calves; the CK level was increased in one case, which improved easily with steroid therapy.[4–7]

In our case, skin biopsies of the new purpura were performed, and histopathological testing revealed fibrinoid degeneration of medium-sized arterioles in subcutaneous adipose tissue, confirming the diagnosis of necrotizing angiitis. Histopathological examination of the tibialis anterior muscle showed degeneration with neutrophil and lymphocyte infiltration, and the arteries, the walls of which had degenerated under adipose tissue and above the muscle in the amputated lower limb (Figure 2). Contrast-enhanced CT revealed no arterial aneurysm; however, massive vasculitis in subcutaneous adipose tissue and above the muscle caused impaired intramuscular blood flow and inflammation in the muscle, which was thought to have caused compartment syndrome, and no organ disorders other than those of the skin and muscle were observed. In our literature search, apart from our patient, only one

TABLE 1 Case reports of cutaneous arteritis with limited skin and muscle symptoms

Age	Gender	Livedo	Purpura	Ulcer	Swelling	CK	Procalcitonin	Pulse Intravenous methylprednisolone	Immunosuppressant	Amputation	Author
51	M	+	+	+	N/A	–	N/A	–	+	–	Nemoto[11]
36	F	N/A	N/A	–	+	N/A	N/A	–	+	–	Ahmed[12]
39	F	+	–	–	+	–	N/A	+	+	–	Tripoli[13]
69	M	–	+	–	+	N/A	N/A	–	–	–	Endo[14]
76	M	–	+	+	+	+	+	+	+	+	Our case

other case of PAN with concurrent compartment syndrome has been reported.[8] Given these findings, a diagnosis of CA with limited skin and muscle symptoms was confirmed. In this patient, the compartment syndrome might be caused by impaired blood flow arising from a CA-related peripheral artery aneurysm rupture. CA can be accompanied by peripheral neuropathy and muscle disorders, but these symptoms are limited to the same area as the skin lesions.[3] We consider that CA with muscle disorders may be a severe type of CA.

Our literature search yielded no reports of abnormally elevated PCT levels in patients with CA. Therefore, this is the first case report of CA with an elevated PCT level. In general, cytokines, such as TNF-α, stimulated by bacterial cells and endotoxins produce PCT.[9] In addition, the severity of abdominal compartment syndrome is related to the PCT level.[10] In our case, antibiotic treatment was ineffective for the cutaneous and muscular symptoms. The negative results of the bacterial culture tests and for necrotizing fasciitis suggested collagen disease. The elevated PCT level in this case may have been induced by the production of inflammatory cytokines after the marked soft tissue injury due to compartment syndrome. The elevated PCT level decreased rapidly after the relaxing incision.

A literature review was conducted for CA with muscle disorders. We searched for case reports describing cases with both skin lesions and muscle disorders based on biopsy or medical imaging, and found five cases, including the case presented here (Table 1).[11–14] All cases had swelling, and we considered that the presence of swelling might be useful for differential diagnoses between CA with and without muscle disorders. Oral steroid therapy was not effective in two cases, including our case, and four cases, including our case, required immunosuppressants or intravenous methylprednisolone pulse therapy. Our case had compartment syndrome, which resulted in a highly elevated serum PCT concentration. The accumulation of similar cases is anticipated to determine the appropriate diagnosis.

In conclusion, we report the first case of CA with an elevated PCT level caused by compartment syndrome. CA cases with swelling and elevated PCT levels may respond poorly to internal treatments, such as oral steroid therapy, resulting in the use of pulse intravenous methylprednisolone, immunosuppressive therapy, and below-the-knee amputation.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DECLARATION SECTION

Approval of the research protocol: N/A.
Informed Consent: Informed consent was obtained from the patient.
Registry and the Registration No. of the study/trial: N/A.
Animal Studies: N/A.

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