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【 CASE REPORT 】

Two Patients with Paget-Schroetter Syndrome That Were Successfully Diagnosed by Doppler Ultrasonography: Case Studies with a Literature Review

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Abstract:

We herein report on two male patients (age, 22 and 44 years) who were referred to our department with swelling of the upper right arm after attending other hospitals. Right subclavian vein thrombosis was demonstrated by ultrasonography and they were then further evaluated by contrast-enhanced computed tomography (CT). Successful treatment involved venous thrombectomy in one patient and anticoagulant therapy in the other. Paget-Schhroetter syndrome was confirmed using standard vascular ultrasonography. Despite the accuracy of this method for diagnosing Paget-Schroetter syndrome, some cases are difficult to confirm. We reviewed 29 previously published case reports of Paget-Schroetter syndrome and analyzed the patient baseline characteristics, time to diagnosis, and the diagnostic methods used.

Key words: Paget-Shroetter syndrome, deep vein thrombosis, diagnostic error, upper extremity thrombosis, doppler ultrasonography, effort thrombosis

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Introduction

Upper extremity thrombosis, also known as Paget-Schroetter syndrome (PSS), typically involves the subclavian-axillary vein and accounts for 2-3% of deep vein thrombosis cases (1). PSS is associated with the repetitive strenuous external rotation of the arm, which causes chronic damage to the endothelium which eventually leads to vein thrombosis (2). As PSS is often misdiagnosed, we herein describe two cases that were encountered at our hospital and review them while comparing their findings with other published case reports regarding the characteristics of PSS in order to help reduce the occurrence of diagnostic errors.

Case Reports

Case 1

A 25-year-old man (height, 172 cm; weight, 63 kg) working as a gasline plumber presented at our hospital with coldness, swelling, and pain in the upper limbs and general malaise. On the first day of the illness, he noticed these symptoms while he was at work. He initially visited a primary care clinic where cellulitis was suspected; he was then sent to an orthopedics department. On the same day, cellulitis was ruled out, and he was sent to a cardiologist to examine the circulation of his upper right arm. A cardiologist ordered vascular ultrasonography for screening the axillary artery, and a medical technician performed routine ultrasonography. Vascular ultrasonography revealed no significant difference between the right and left axillary artery diameters. Further-

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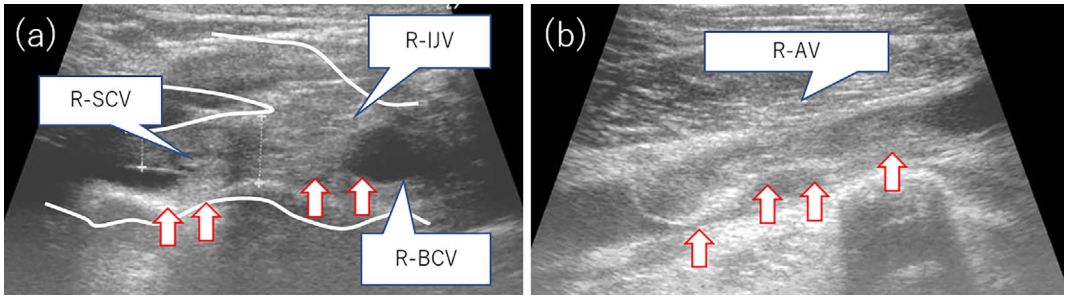

Figure 1. **(a) An ultrasonogram showing thrombus in the right subclavian vein (R-SCV). (b) An ultrasonogram showing thrombus in the right axillary vein (R-AV). R-IJV: right internal juggler vein, R-BCV: right brachiocephalic vein**

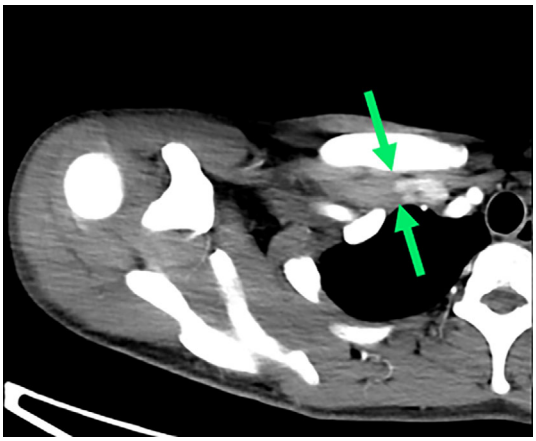

Figure 2. **Contrast-enhanced CT showing occlusive thrombus in the right subclavian vein.**

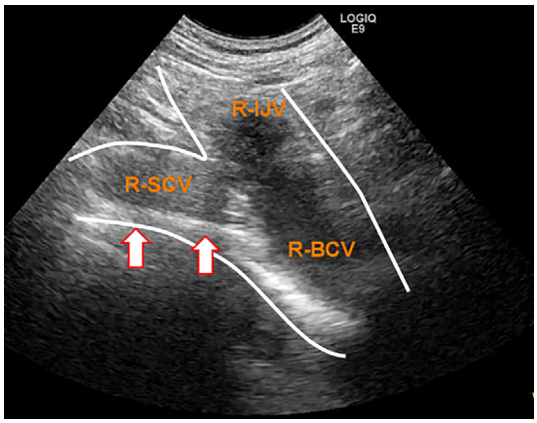

Figure 3. **An ultrasonogram showing thrombus in the R-SCV.**

more, the blood flow demonstrated different speeds between the right and left artery; however, the results were considered to be normal and the subclavian vein was not examined either.

Owing to a suspicion of lymphedema, he was referred to our hospital. The patient had no significant past medical history. Physical examination revealed that his upper right arm circumference was larger than that of his left arm. The Wright and Roos test was positive. Moreover, laboratory data showed a slight elevation in the D-dimer level (0.6 μg/mL), but no abnormalities in the protein C, protein S, and antithrombin levels. Chest X-ray and Electrocardiography (ECG) showed normal findings. However, the symptoms had an acute onset in young males; therefore, we suspected vascular occlusion specifically for the venous part instead of lymphedema. Vascular ultrasonography revealed stenosis of the subclavian-axillary vein (Fig. 1), and we evaluated the thrombosis using contrast-enhanced computed tomography (CT) (Fig. 2). On admission, he began anticoagulant therapy with heparin and apixaban. After 5 days of treatment, we confirmed that the thrombosis had gradually became smaller, and heparin treatment was thus discontinued.

After 7 weeks, his symptoms and the thrombosis remained; therefore, he was re-admitted to the hospital to undergo venous thrombectomy. Apixaban was switched to warfarin, and his prothrombin time was monitored because of his poor compliance with oral intake. Contrast-enhanced CT performed 1 week after surgery revealed a resolution of the thrombus, and warfarin administration was stopped after 6 months. A follow-up examination 2 years later showed that the thrombosis had not recurred.

Case 2

A 41-year-old man (height, 167 cm; weight, 67 kg) with an abrupt onset of swelling, redness, and pain in his upper arm was referred from a primary care clinic to our hospital. The symptoms had begun 7 days earlier while he was playing badminton. He was on medication for bronchial asthma, but otherwise was a healthy right-handed person who regularly played badminton. Physical examination revealed swelling in his right upper arm, which was 7 cm larger than the left arm. The right forearm was 4 cm greater in circumference than the left forearm. The Roos test was positive. Laboratory data showed a slight elevation in the D-dimer level (0.8 μg/mL) and no abnormality in the protein C, protein S, and antithrombin levels. Tests for lupus anticoagulant, antinuclear antibody, and cardiolipin antibody were negative. Due to a similar history and onset with the previous case, we suspected PSS; therefore, we decided to examine the vascular system including the vein. Vascular ultrasonography revealed stenosis of the subclavian-axillary vein (Fig. 3). In addition, contrast-enhanced CT showed the presence of a pulmonary embolism (Fig. 4). Anticoagulation

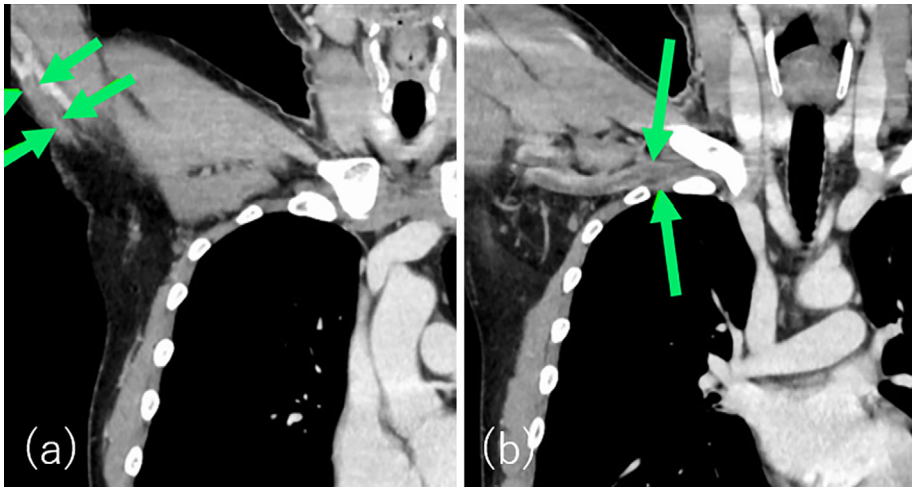

Figure 4. **(a) Contrast-enhanced computed tomography (CT) showing occlusive thrombus in the right axillary vein (R-AV). (b) Contrast-enhanced CT showing occlusive thrombus in the right subclavian vein (R-SCV).**

Table 1. **Baseline Characteristics of Patients in Published Case Reports.**

		Number of patients
Sex	male	23
	female	7
Age	mean±SD	31.6±12
Family history of coagulopathy		1
Symptoms	skin color change	17/27
	pain	17/29
	swelling	29/29
Affected limb	right	13
	left	12
	bilateral	4
Pulmonary embolism		6/22
Therapy	anticoagulant	27
	endothelial surgery	11
	rib resection	7

SD: standard deviation

Table 2. **Examinations Conducted, Time until Diagnosis, and Primary Diagnosis.**

Definitive diagnosis	U/S	22 patients
	CT	6 patients
	venography	1 patient
Time until diagnosis	median	3 days
	range	1 day to 3 months
Department first visited	emergency	12 patients
	primary care	5 patients
Primary diagnosis	cellulitis	3 patients
	muscle strain	1 patient
	unknown	2 patients

U/S: ultrasonography

therapy with warfarin was administered for 6 months, and no relapse was observed.

Discussion

A sudden onset of upper limb swelling could be an early manifestation of PSS, thus requiring the need to perform vascular ultrasonography examinations of the brachiocephalic and subclavian vein.

Similar to Case 1, without being aware of PSS, Doppler ultrasonography can result in a diagnostic error when compared to a successful diagnosis with venous ultrasonography in case 2 where PSS was included in the differential diagnosis on the first referral.

In case 1, upper thrombosis was not detected by the first round of vascular ultrasonography examinations because the possibility of venous thrombosis was not taken into consideration. Therefore, it is important to perform ultrasonography while including PSS in the differential diagnosis, otherwise, there is a risk of a diagnostic error occurring.

Coldness accompanied with swelling of upper limb may indicate PSS, however, we found only 1 case report that previously described these symptoms (3).

However, Di Nisio et al. reported the sensitivity of compression, Doppler ultrasonography, and Doppler ultrasound with a compression of 97%, 84%, and 81%, respectively, while they had specificities of 96%, 94%, and 93%, respectively (4). To investigate this discrepancy, we reviewed the baseline characteristics of patients described in 29 published cases (Table 1); the time until diagnosis from the initial symptoms, the examinations conducted for diagnosis, the primary diagnosis (Table 2) the and risk factors (Table 3). The reviewed cased were found in a PubMed search of publications in the past 5 years using the search term PSS. A total of 29 cases were found, but one report could not be analyzed (5). Including our two cases, the majority of patients were male (23 : 8), with a mean age of 31.6 years. Only one patient had a history of coagulopathy (6). The left

Table 3. Occupational or Sports-related Risk Factors (Number of Patients).

Weightlifting	8	Cameraman	1
Rock climbing	2	Cheerleading	1
Swimming	2	Violin	1
Waiter	2	Triathlon	1
Surfing	1	Track and field	1
Saxophone player	1	Kaatsu training	1
Baseball player	1	Kayak guide	1
Badminton	1	Package delivery	1

and right upper arms were equally affected (right, 13 cases (5-15); left, 13 cases (16-27). In four patients, both sides were affected (20, 28-30). All patients had swelling of the upper arm, skin color change, and pain. In 22 cases, PSS was confirmed via vascular ultrasonography examinations (6-10, 13-15, 17, 19, 20, 22-26, 28, 29). A diagnosis of PSS was made after an average of 10 days. However, in nine cases, the diagnosis was made on the first or second day after arrival at the hospital (6, 13, 17, 20, 21, 28-30); in one case, the diagnosis took 3 months (13), thus displaying a wide range in the time period required for the identification of this condition. Vascular ultrasonography has a high diagnostic accuracy for PSS (4), however, it is not normally performed unless physicians consider PSS in the differential diagnosis. Fourteen patients first presented to an emergency department (9, 13, 17, 20, 21, 24-27), which was the most frequent department visited in our research. Five patients were first seen at a primary care clinic (3, 7, 8). Based on this frequency, it might be suggested that physicians in general internal medicine encounter this case the most. An error in diagnosis was observed in four cases, with the diagnosis of soft-tissue inflammation in three cases (7, 10), and a bicep tear was suspected in one case during their first visit (21). However, for two cases, there was no mention of the primary diagnosis. Mostly, PSS affects young healthy males, and physicians might misdiagnose it as musculoskeletal disorders. Weightlifting was considered to be a risk factor in eight cited cases (6, 15, 20, 21, 23, 25, 27, 29), and rock climbing, working as a waiter, and swimming were reported to be risk factors in two cases.

PSS most often occurs in young, healthy athletes who perform vigorous upper limb activity. Although the sensitivity and specificity of vascular ultrasonography for diagnosing PSS are high, an error in diagnosis was made in 6 of the 29 cases included in our literature review. Thus, the vascular pathophysiology should be carefully considered when ordering ultrasonography for PSS, including examinations of the subclavian vein, which is important for preventing a delayed diagnosis of PSS.

The authors state that they have no Conflict of Interest (COI).

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