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IMAGING VIGNETTE

CLINICAL VIGNETTE

Hyperabduction During Balloon Inflation in the Subclavian Vein as a Test for Thoracic Outlet Syndrome

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ABSTRACT

We present a case of venous thoracic outlet syndrome involving upper extremity venous thrombosis confirmed by hyperabduction during balloon inflation in the subclavian vein. This provocative test provides clear evidence of extrinsic venous compression, confirming venous thoracic outlet syndrome. (J Am Coll Cardiol Case Rep 2024;■:102338) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

A right-handed 17-year-old male presented with swelling of the nondominant (left) arm of 24 hours' duration. A duplex scan showed an occlusive thrombus in the left subclavian vein, which was also confirmed by magnetic resonance venography. The patient was anticoagulated with enoxaparin and taken to the catheterization laboratory on day 2 of hospitalization. Venography confirmed complete thrombotic occlusion of the left subclavian and left axillary veins. Directed pharmacomechanical thrombolysis was initiated with tissue plasminogen activator infusion at a rate of 1 mg/h using an EKOS catheter (Boston Scientific). He required 4 days of thrombolysis because of persistent occlusion on Doppler ultrasound, after which the EKOS catheter was removed, and a venogram showed mild narrowing of the left subclavian vein without thrombus. To determine if the area of narrowing was caused by bony compression, provocative testing to evaluate for thoracic outlet syndrome was performed by inflating a 10 mm × 4 cm balloon at low pressure (2 atm) in the left subclavian vein centered at the junction of the left first rib and the left clavicle. With the patient sedated, his arm was manually abducted with the balloon inflated (**Figures 1A to 1C**). This showed significant compression of the balloon between the inferior border of the clavicle and the medial border of the first rib during hyperabduction of the arm that resolved with adduction. The patient was discharged on chronic anticoagulation with oral rivaroxaban 20 mg daily and underwent thoracic outlet decompression through left first rib resection 2 months later. One month after rib resection, venography revealed no evidence of stenosis or thrombosis, and repeat provocative testing with balloon inflation in the subclavian vein showed no evidence of compression with hyperabduction of the left upper extremity (**Figures 1D to 1F**). The anticoagulation was discontinued, and antiplatelet therapy was started with oral aspirin 81 mg daily. He remains asymptomatic.

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ABBREVIATIONS AND ACRONYMS

VTOS = venous thoracic outlet syndrome

DISCUSSION

Venous thoracic outlet syndrome (VTOS) is primarily caused by bony compression of the axillary/subclavian vein between the clavicle and the first rib[1] and represents a major cause of upper extremity deep venous thrombosis. Venous stenosis may persist after thrombolysis, and it is important to differentiate intrinsic venous stenosis from extrinsic compression because the latter requires surgical decompression of the thoracic outlet. Provocative tests may assist in diagnosing VTOS. The use of balloon dilation during arm hyperabduction has been reported in conjunction with intravascular ultrasound,[2] although our case illustrates that balloon dilation alone may be sufficient.

Herein, we describe a patient with suspected VTOS in the nondominant arm with mild persistent stenosis after thrombolysis. Provocative testing consisting of hyperabduction of the affected arm with simultaneous balloon inflation in the subclavian vein resulted in clear compression of the balloon precisely at the region of overlap of the clavicle with the first rib, confirming VTOS as the mechanism for thrombosis and justifying first rib resection. This maneuver was repeated after first rib resection with no appreciable balloon compression noted, confirming successful relief of VTOS. This simple provocative test may be performed at the time of venography to confirm VTOS, particularly in unclear cases.

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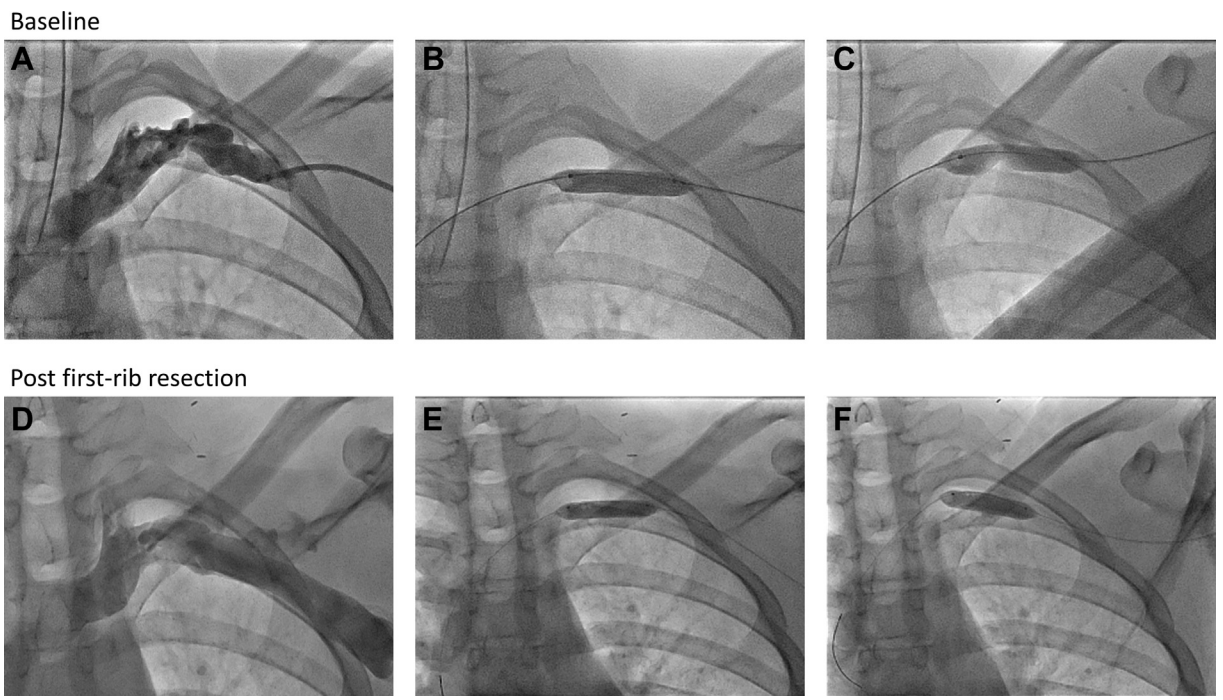
FIGURE 1 Angiography and Provocative Testing



(A) The baseline venogram after thrombolysis showing stenosis of the left subclavian vein at the overlap of the clavicle and the first rib present even in adduction. (B) A 10-mm balloon is inflated in the left subclavian vein with no indentation noted in adduction. (C) With hyperabduction, indentation is seen on the balloon at the precise location of overlap between the lateral aspect of the clavicle and the medial aspect of the first rib (note the wire course that confirms abduction of the arm). (D) Venography showing widely patent left subclavian and axillary veins after first rib resection. (E) A 10-mm balloon is inflated in the left subclavian vein with no indentation noted in adduction. (F) Despite hyperabduction, no indentation is noted in the balloon after first rib resection (note the wire course that confirms abduction of the arm).

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KEY WORDS deep vein thrombosis, Paget-Schroetter syndrome, provocative testing, venous thoracic outlet syndrome