Managing Paget-Schroetter Syndrome

In the absence of randomized controlled trials, current practice has been guided by retrospective reviews and experience.

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Paget-Schroetter syndrome, which is also known as effort thrombosis of the axillosubclavian vein, accounts for approximately 1% to 2% of all episodes of venous thromboses.[1] The estimated incidence in the United States is between 3,000 and 6,000 cases per year.[2] Paget-Schroetter syndrome typically occurs in younger patients who participate in competitive athletics or who are involved in a physically demanding occupation. Approximately 80% of patients with Paget-Schroetter syndrome report strenuous physical activity involving the upper extremities.[1] The mean age of these patients at presentation is in the early 30s, and the syndrome is more common in men, with a 2:1 male-to-female ratio.[1] Paget-Schroetter syndrome more commonly occurs on the right side in comparison to the left, as the majority of the population is right-handed.

The mechanism of Paget-Schroetter syndrome is compression of the subclavian vein as it courses through the anterior thoracic outlet at the junction of the first rib and clavicle, as well as between the subclavius and anterior scalene muscles. Hypertrophy of the pectoral muscles, typically the subclavius muscle, causes narrowing of the costoclavicular angle and results in compression of the subclavian vein.[3] Repetitive shoulder abduction causes shearing injury to the vein. As a result, over time, a rind of fibrotic tissue develops surrounding the subclavian vein. Because of repetitive trauma to the vein, the venous wall becomes thickened and fibrotic. Intimal damage results in a rough, thrombogenic surface that increases the risk of deep vein thrombosis. Patients with Paget-Schroetter syndrome often develop collateral vessels, known as *first rib bypass collaterals*.

At presentation, patients commonly complain of rapid onset of a swollen, blue arm. They typically experience pain and a sensation of heaviness. In these patients, sonographic evaluation of the upper extremity reveals the presence of an axillosubclavian deep vein thrombosis. It is important at the time of diagnosis to distinguish Paget-Schroetter syndrome

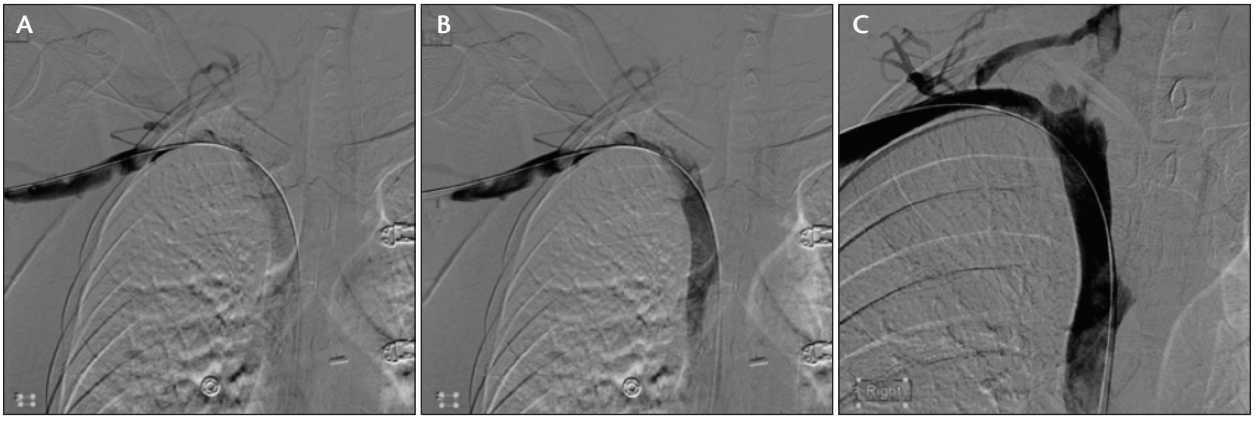

Figure 1. The initial venogram of the axillosubclavian venous system in a 21-year-old right-handed collegiate third baseman (A, B) demonstrates a significant amount of thrombus within the subclavian vein at the junction of the clavicle and first rib with evidence of first rib bypass collaterals. A follow-up venogram after CDT (C) demonstrates no residual thrombus within the subclavian vein. There is mild residual stenosis of the subclavian vein at the junction of the clavicle and first rib with persistent first rib bypass collaterals.

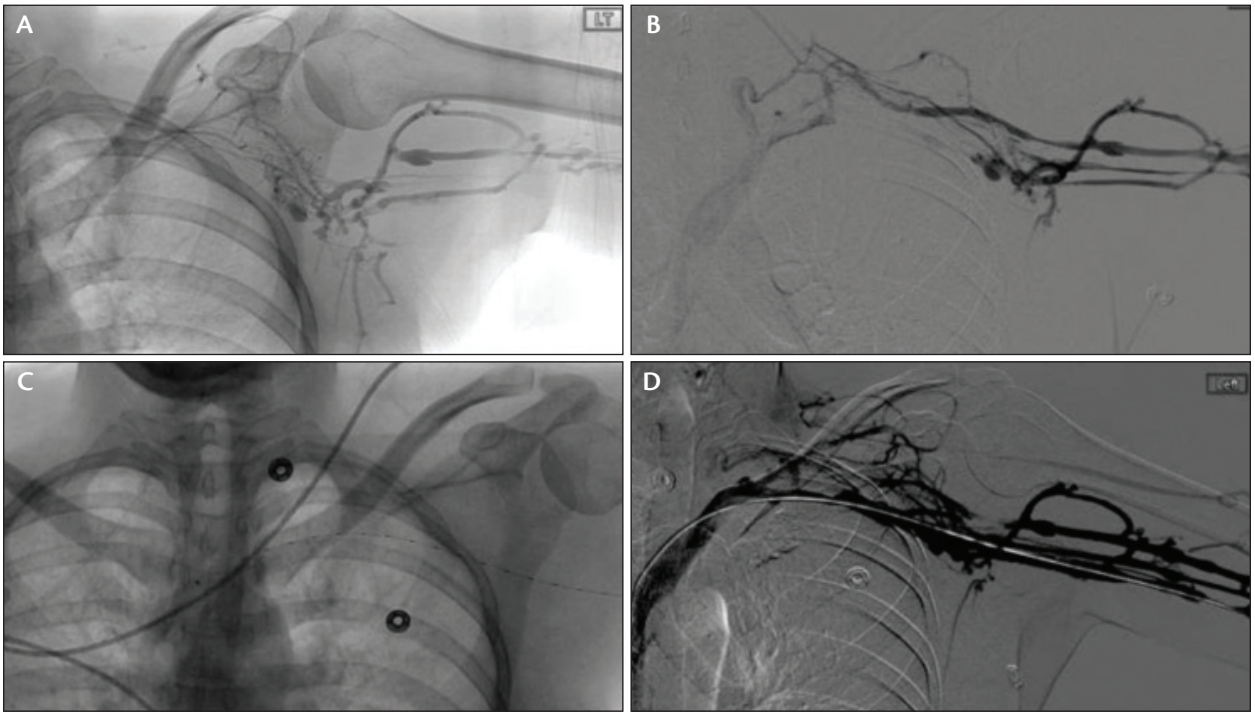

Figure 2. Venograms in a 25-year-old left-handed quarterback (A, B) show thrombus within the left subclavian vein, as well as first rib bypass collaterals. Thrombolysis was performed using an Ekos catheter (C). The postthrombolysis venogram (D) shows no residual thrombus; however, there is residual stenosis at the junction of the first rib and clavicle with the arm in the abducted position.

from an axillosubclavian thrombus secondary to an indwelling venous catheter, pacemaker wires, or vessel injury from attempted catheter placement, as thrombus resulting from these entities can be successfully treated with anticoagulation alone.[2,3]

ROLE OF THROMBOLYTIC THERAPY

The treatment of Paget-Schroetter syndrome is somewhat controversial, as there have not been large, prospective, randomized controlled trials to compare various treatment strategies. Current practices have been guided by retrospective reviews and expert opinion.[2] Many advocate catheter-directed thrombolysis (CDT) followed by decompressive surgery, venography with possible venoplasty, and anticoagulation.[1,3] Others advocate CDT followed by anticoagulation and choose to reserve surgical decompression for patients with persistent upper extremity swelling and pain. However, patients who do not undergo surgical decompression typically face a greater risk of rethrombosis.[1-4]

Although CDT therapy treats the axillosubclavian thrombus, it does not address the underlying mechanism of extrinsic compression that promotes thrombus formation. An initial venogram and a postthrombolysis venogram are shown in Figure 1 for a 21-year-old right-handed collegiate third baseman with Paget-Schroetter syndrome. The initial venogram (Figure 1A and 1B) shows a significant amount of thrombus within the right subclavian vein at the junction of the clavicle and first rib with first rib bypass collaterals. The follow-up venogram after thrombolysis shows interval resolution of the thrombus in the right subclavian vein with mild residual stenosis of the vein at the junction of the clavicle and first rib. Sajid et al performed a systematic review and found that out of 262 patients treated with thrombolysis without surgical decompression, 62 patients (23%) reported persistence of symptoms, and 18 patients (7%) were found to have rethrombosis.[4] Rethrombosis within 30 days has been reported in up to one-third of patients treated with thrombolysis alone.[2]

CDT is most successful when performed within 10 to 14 days of thrombus formation, with the time between thrombus formation and thrombolysis being one of the most important predictors of treatment outcome.[2,3,5] Doyle et al followed a cohort of patients who underwent thrombolysis within 14 days of symptom onset before surgical decompression and reported a primary patency rate at 5 years of 84%.[6] The mechanism of CDT widely varies from center to center but generally involves antegrade venous access from the arm, with subsequent crossing of the lesion and initiation of lysis through a multisidehole catheter (eg, the Cragg-McNamara catheter, Covidien) or with adjunctive ultrasonic thrombolysis (Ekos Corporation, a BTG International group company).

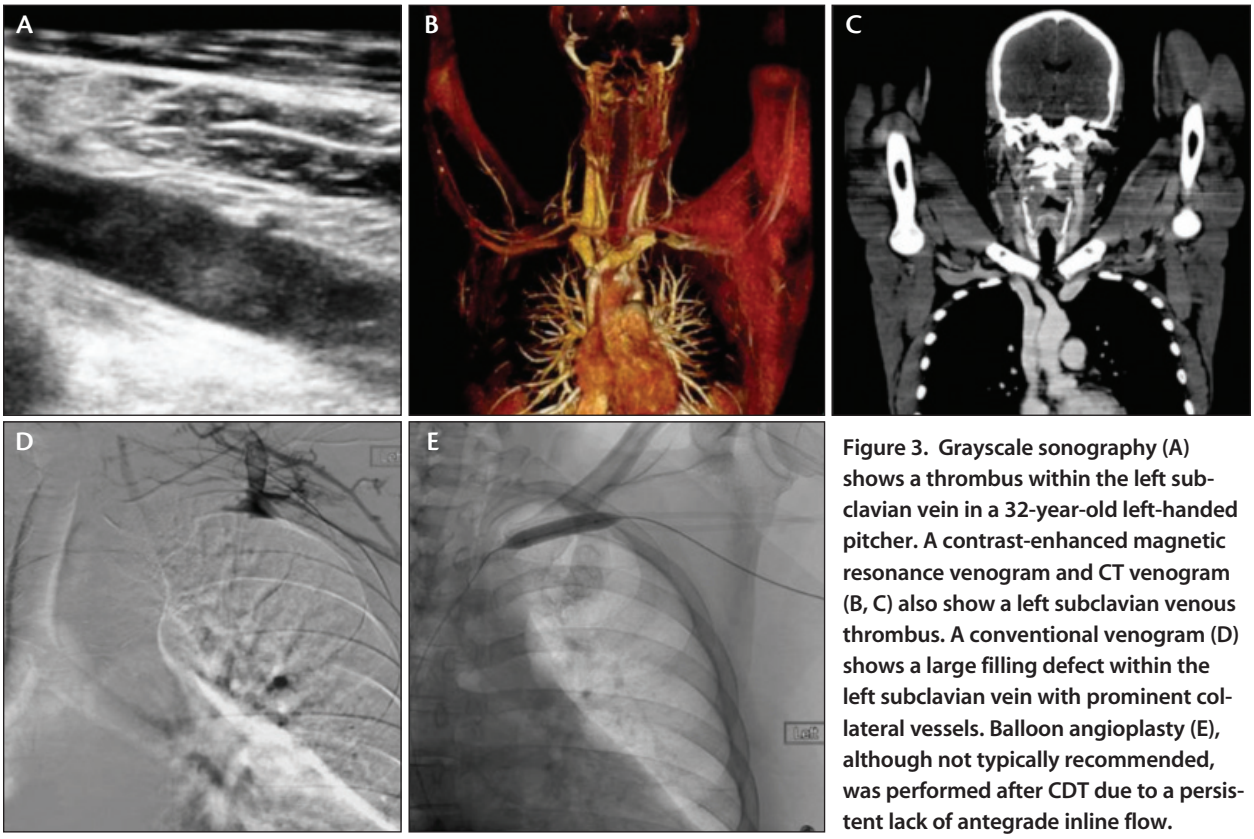

Figure 3. Grayscale sonography (A) shows a thrombus within the left subclavian vein in a 32-year-old left-handed pitcher. A contrast-enhanced magnetic resonance venogram and CT venogram (B, C) also show a left subclavian venous thrombus. A conventional venogram (D) shows a large filling defect within the left subclavian vein with prominent collateral vessels. Balloon angioplasty (E), although not typically recommended, was performed after CDT due to a persistent lack of antegrade inline flow.

Tissue plasminogen activator is typically administered for 24 hours at a rate of 0.5 to 1 mg per hour, along with unfractionated heparin at a rate of 250 IU per hour to decrease the risk of pericatheter thrombus formation. Repeat venography is performed after 24 hours. Figure 2 shows a left subclavian thrombus with first rib bypass collaterals in a 25-year-old left-handed quarterback (Figure 2A and 2B). Thrombolysis using an Ekos catheter was performed (Figure 2C), and a postthrombolysis venogram (Figure 2D) shows resolution of the thrombus but residual stenosis at the junction of the first rib and clavicle. If thrombus is still present, thrombolysis can be continued with repeat venography the next day. Angioplasty is not recommended at this time, as it may increase the risk of rethrombosis by causing endothelial damage.[2,3]

Anticoagulation alone has been shown to be ineffective, as it also does not address the underlying mechanism for thrombus development. Persson et al followed patients with primary upper extremity deep vein thrombosis treated with anticoagulation alone and found that at 5 years, 58% had evidence of residual thrombus on ultrasound, and 77% had persistent symptoms.[7] In the cohort studied by Urschel and Razzuk, 62% of patients treated with anticoagulation alone had recurrent symptoms.[8] Furthermore, in patients treated with anticoagulation alone, acute pulmonary embolus has been reported in 14% of cases.[9]

Additionally, angioplasty and stent placement before surgical decompression has been largely unsuccessful and is not recommended.[2,3,6,10,11] Stent placement frequently results in stent fracture due to mechanical compression from the clavicle overlying the first rib.[6,10,11] Urschel and Patel found that all 22 patients in their cohort treated with intravenous stents developed venous reocclusion within 6 weeks.[11] In addition, it has been hypothesized that venoplasty can cause endothelium damage, creating a thrombogenic surface that may increase the risk of early rethrombosis.[2,3] Figure 3 shows a left subclavian venous thrombus in a 32-year-old left-handed pitcher. Grayscale sonographic, contrast-enhanced magnetic resonance venographic, CT venographic, and conventional venographic images of the left subclavian venous thrombus are provided in Figure 3A through 3D. As shown in Figure 3E, although not recommended, balloon venoplasty was performed after CDT.

SURGICAL DECOMPRESSION

It is generally agreed upon that surgical decompression, if feasible, results in the most optimal outcomes for patients with Paget-Schroetter syndrome. Surgical decompression is commonly achieved via first rib resection. This can be performed through either a transaxillary or paraclavicular approach.[12] The transaxillary approach involves freeing the vein but does not require venous reconstruction. Because this approach does not disturb the pectoral muscles, it

is often preferred for competitive athletes who desire to resume their athletic careers.[13] The paraclavicular approach, on the other hand, allows for reconstruction of the subclavian vein as needed.[12]

The timing of surgical decompression is somewhat controversial. Many believe that the outcomes are optimized with early surgical decompression.[1,14,15] At many institutions, these patients are placed on the next elective list for scheduling. In the early 1990s, due to concerns over the risks of operating too soon after thrombolysis, surgical decompression was typically performed 3 months after thrombolysis.[16] However, with this approach, it has been reported that rethrombosis occurred in 10% of patients.[2] Because of the risk of rethrombosis, many surgeons now prefer early surgical decompression to late surgical decompression.[17]

Despite the growing popularity of aggressive, early surgical intervention, some groups, including a group at Stanford, preferred a more conservative approach with CDT and subsequent anticoagulation, choosing to reserve surgical decompression for patients who experience persistent symptoms.[18] However, this approach has been recently abandoned by the Stanford group in favor of early surgical intervention.[19] With regard to outcomes, Illig and Doyle suggest that successful outcomes are likely achieved in 80% to 90% of patients treated with thrombolysis followed by late decompression compared to 90% to 95% of patients treated with thrombolysis followed by early decompression.[2]

Furthermore, it is generally agreed upon that patients should be anticoagulated after surgical decompression. However, no large studies have investigated the outcomes associated with varying durations of anticoagulation. Despite the lack of substantial evidence to support a particular duration of anticoagulation, these patients are typically anticoagulated for 3 months, although some institutions prefer anticoagulation for 6 months.

FOLLOW-UP VENOGRAPHY

Follow-up venography is recommended 2 to 3 weeks after surgical decompression to assess for residual stenosis. At this time, venoplasty should be performed as needed. It is not recommended to perform venography sooner than 2 to 3 weeks after surgical decompression, because if it is performed within this postoperative period and rethrombosis is indeed detected, thrombolysis would be contraindicated due to the risk of hemorrhage. Restenosis is uncommon; however, this can usually be successfully treated with conventional angioplasty at 10 atm with or without cutting-balloon angioplasty.[3]

CONCLUSION

There have been no large, prospective, randomized controlled trials comparing the treatment efficacies of various management strategies for patients with Paget-Schroetter syndrome. Despite the lack of substantial randomized, controlled evidence, patients with Paget-Schroetter syndrome are typically treated with CDT followed by decompressive surgery, venography with possible venoplasty, and anticoagulation. Some physicians prefer a more conservative approach, opting to treat these patients with CDT followed by anticoagulation, and choose to reserve surgical decompression for patients with persistent symptoms. With this approach, however, patients typically face a greater risk of rethrombosis. Furthermore, angioplasty and stent placement prior to surgical decompression is not recommended, as it can result in stent fracture due to mechanical compression at the junction of the clavicle and first rib. ■

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