Posterior sternoclavicular dislocation is an uncommon injury and often remains initially undiagnosed due to variable clinical presentation and inadequate visualization of the joint on plain radiographs. It is frequently associated with serious and life-threatening injuries involving the trachea, esophagus, or great vessels.

A 15-year-old boy was knocked to the ground during wrestling and landed on his left shoulder. He presented 6 days after trauma with increasing arm swelling and pain. A Doppler ultrasound revealed deep vein thrombosis involving the left shoulder and arm. Contrast-enhanced computed tomography of the chest confirmed the diagnosis of left posterior sternoclavicular dislocation with the medial end of left clavicle compressing the underlying brachiocephalic vein. Venous duplex scan confirmed acute venous thrombosis of the left jugular and subclavian veins. Open reduction of the left posterior sternoclavicular dislocation was performed under general anesthesia with cardiothoracic surgery backup. The reduced joint was stable, negating the need for internal fixation. Postoperatively, the pain and arm swelling gradually subsided, and patient recovered well with no complications.

Deep vein thrombosis has not been reported as a presenting symptom for posterior sternoclavicular dislocation. Orthopedic, trauma, and thoracic surgeons should be aware of this presentation and obtain a chest computed tomography scan with 3-dimensional reconstruction to confirm the diagnosis. In cases of posterior sternoclavicular dislocation with vascular compromise, patients should immediately undergo open reduction with or without internal fixation.
Sternoclavicular joint dislocations are uncommon and represent 3% of major injuries to the shoulder girdle and less than 1% of all dislocations. Anterior dislocations are more common and have a less complicated presentation; however, posterior sternoclavicular dislocations present with serious injuries to the mediastinal structures. Since Sir Astley Cooper first described this injury in 1824, approximately 130 cases have been reported in English literature; however, none of these presented with upper-extremity deep vein thrombosis (DVT) secondary to brachiocephalic vein compression. This describes a case of a patient with a left shoulder girdle injury who presented 6 days after trauma with upper-extremity DVT. The patient was managed with open reduction without internal fixation and recovered well with no neurovascular complications at last follow-up.

**CASE REPORT**

During a wrestling match, a 15-year-old-boy was slammed to the ground by his opponent and landed on his left shoulder. At a primary clinic, a straight anteroposterior chest radiograph was read as normal. The patient was discharged in a sling and returned with increasing arm swelling and pain on postinjury day 6. He was then referred to the authors for further evaluation and management.

At presentation, he reported increasing arm swelling with pain and no history of dysphagia, dyspnea, stridor, voice change, neck pain, facial swelling and paresthesias, or upper-extremity weakness. Examination revealed swelling of his left arm that also involved the left hand. Asymmetric swelling existed over the left sternoclavicular joint. His left shoulder movements were limited due to pain. He had bilaterally equal hand grips, normal capillary refill, and palpable distal pulsations. The neck veins were not distended.

Ultrasound examination of upper-extremity swelling demonstrated DVT. The vascular service was consulted, and heparin infusion was initiated. Contrast-enhanced computed tomography (CT) scans of the neck and chest confirmed the diagnosis of posterior dislocation of the left clavicle with brachiocephalic vein compression (Figures 1, 2). No contrast was identified in the left subclavian and axillary veins, and a filling defect was found below the level of C4 in the left internal jugular vein. Venous duplex scan confirmed acute DVT of the left jugular and left subclavian veins.

The patient’s family gave informed consent for surgery. The cardiothoracic surgery team was available as backup. Under general anesthesia and adequate muscle relaxation, a 4-cm horizontal incision was made on the skin overlying the left sternoclavicular joint. After meticulous dissection, the posteriorly lying medial clavicle was identified. Under continuous left upper-extremity traction, it was atraumatically reduced with a towel clip. Reduction was ascertained to be stable under direct examination, and no internal fixation was required. The wound was thoroughly irrigated and closed in layers, and the patient recovered uneventfully.

Postoperatively, the arm swelling and pain resolved, and the joint was protected in a sling for 6 weeks. At 12-week follow-up; he was doing well and had initiated gradual shoulder range of motion exercises. He reported no discomfort or pain over the left sternoclavicular joint. Participations in contact sports were restricted until 6-month follow-up.

**DISCUSSION**

**Anatomy and Mechanism of Injury**

The sternoclavicular joint links the upper extremity with the axial skeleton. Anatomically, it is a saddle-type synovial joint, but functionally, its range of motion is comparable to a ball-and-socket joint. The sternoclavicular joint is inherently unstable and incongruent because less than half of the medial end of the clavicle articulates with the sternum. An intra-articular disk partially compensates for the incongruence, and much of the joint stability relies on periarticular ligament (intra-articular disk ligament, intercavicular ligament, and capsular ligaments) and extra-articular ligaments (costoclavicular ligament). The posterior capsular ligament is sturdier than the anterior capsular ligament, and greater force is required to dislocate the joint posteriorly than anteriorly. The costoclavicular ligament provides the strongest support and connects the medial end of the clavicle to the first rib and its corresponding costal cartilage. Vital mediastinal structures lie in close proximity posterior to each sternoclavicular joint. On the right, the brachiocephalic vein and artery, and on the left, the bra-
Dysphagia; systolic cervical Hoarseness of voice; voice changes; pneumothorax
Clinical Manifestation

<table>
<thead>
<tr>
<th>Mediastinal Structure Compressed by Posteriorly Dislocated Medial Clavicle</th>
<th>Clinical Manifestation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subclavian artery brachiophinic artery (on the right side)</td>
<td>Acute limb ischemia; pulses may diminish on arm abduction; systolic cervical murmur; cerebrovascular stroke</td>
</tr>
<tr>
<td>Innominate or subclavian vein compression or laceration</td>
<td>Edema and cyanosis of the arm; DVT of arm; death</td>
</tr>
<tr>
<td>Tracheal compression/stenosis lung parenchymal injury</td>
<td>Difficulty breathing; tachypnea; stridor; pneumothorax</td>
</tr>
<tr>
<td>Esophageal compression</td>
<td>Dysphagia</td>
</tr>
<tr>
<td>Brachial plexus (C5-T1, anterior rami)</td>
<td>Brachial plexopathy</td>
</tr>
<tr>
<td>Recurrent laryngeal nerve compression</td>
<td>Hoarseness of voice; voice changes</td>
</tr>
</tbody>
</table>

Abbreviation: DVT, deep vein thrombosis.

Table 1

Presentation and Diagnosis

A high index of suspicion is necessary for diagnosing posterior sternoclavicular dislocation because the clinical findings are often subtle. The typical presentation of posterior sternoclavicular dislocation is with pain and swelling around the sternoclavicular joint following a fall and trauma to the shoulder. At presentation, the arm is usually fixed in adduction and internal rotation. The patient may favor the injured joint by flexing and holding the head toward the side of injury. The presence of swelling over the joint often precludes satisfactory palpation, and differentiation between an anterior and posterior dislocation is difficult. Mediastinal compression may be present in up to 30% of all posterior sternoclavicular dislocations and may present with variable symptoms secondary to compression of the brachiocephalic vein or artery, subclavian vein or artery, and trachea and esophagus (Table 1).

In the current patient, painful arm swelling raised the possibility of DVT secondary to compression and stasis, which was confirmed on duplex ultrasound. In the largest case series of 13 pediatric and adolescent patients with posterior sternoclavicular dislocation, the incidence of brachiocephalic vein compression manifesting as cyanosis or upper limb swelling was approximately 10%. Twelve cases are reported with brachiocephalic vein involvement, but none presented with upper-extremity DVT (Table 2). Four of 12 cases presented with laceration of the vein, of which 2 were repaired and 1 resulted in death. A presentation with laceration of the innominate vein–subclavian vein junction was reported, which was repaired using a bovine pericardial patch. Partial to complete compression may manifest, ranging from asymptomatic to cyanosis and swelling of the involved upper extremity.

Following venous obstruction, collateral drainage develops via the jugular veins and superior intercostal veins. In the current case, presentation was delayed by 6 days after injury, which may be long enough to develop DVT but may not be long enough for the collaterals to develop. Arm swelling and pain usually disappear after open reduction and decompression of the brachiocephalic vein. If the patient is asymptomatic after reduction, postoperative venograms are seldom necessary to confirm the venous patency.

Anteroposterior radiographs of the sternoclavicular joint are commonly obtained.
but frequently fail to identify the injury. This is attributed to the oblique orientation of the sternoclavicular joint and the overlapping of ribs and vertebrae on the joint. In a review of 30 cases of posterior sternoclavicular dislocation, an erroneous initial diagnosis was made in 50% of cases. Asymmetry of the 2 sternoclavicular joints may be evident on anteroposterior radiographs, but this is often too subtle to establish the diagnosis. Specialized projections (serendipity, Heinig, Hobbs, and Kattan views) for better visualization of the sternoclavicular joint have been described in the literature. The serendipity view, with 40° to 45° cephalad angulation of the radiograph beam, clearly shows both sternoclavicular joints and is useful and popular. However, contrast CT scan (with 3-dimensional reconstruction, when available) remains the imaging modality of choice because it allows excellent visualization of both sternoclavicular joints, helps evaluate injuries to the surrounding mediastinal structures, and detects clavicular fractures. Occasionally, angiography may be indicated to evalu-

Table 2
Posterior Sternoclavicular Dislocation Presenting With Brachiocephalic Vein Involvement

<table>
<thead>
<tr>
<th>Study</th>
<th>Patient Sex/Age, y</th>
<th>Mechanism of Injury</th>
<th>BCV Injury</th>
<th>Presentation/Diagnosis</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worman &amp; Leagus</td>
<td>M/18</td>
<td>MVA</td>
<td>Compression/laceration</td>
<td>Left PSCD with right pneumothorax, mediastinal hematoma/upright chest radiograph</td>
<td>Thoracotomy, venous ligation</td>
</tr>
<tr>
<td>Southworth &amp; Merritt</td>
<td>M/16</td>
<td>MVA</td>
<td>Compression</td>
<td>Asymptomatic complete right BCV obstruction/CT scan and venogram</td>
<td>CR with towel clip; restoration of flow on repeat venogram</td>
</tr>
<tr>
<td>Cooper et al</td>
<td>M/38</td>
<td>Fall from height</td>
<td>Laceration/tear</td>
<td>Left hydropneumothorax, fractured left 1-3 ribs, transsected left internal mammary artery/intraoperative</td>
<td>Open reduction, resection of anterior end of first rib, sutured tear, Pennig external fixator</td>
</tr>
<tr>
<td>Ono et al</td>
<td>M/41</td>
<td>MVA</td>
<td>Compression</td>
<td>Prominent neck veins, 2-6 rib fractures, cyanosis and swelling of left upper arm, right lung contusion/AP chest radiograph, venogram, and CT scan</td>
<td>CR 6 h after trauma; cyanosis disappeared but asymptomatic venous occlusion persisted</td>
</tr>
<tr>
<td>Thomas et al</td>
<td>M/23</td>
<td>Rugby</td>
<td>Compression</td>
<td>Venous engorgement of right arm, pain, swelling/CT scan 6 wk after injury</td>
<td>Open reduction</td>
</tr>
<tr>
<td>Ege et al</td>
<td>F/36</td>
<td>No trauma</td>
<td>Compression</td>
<td>Effort dyspnea for 2 y, congestion and mild cyanosis of left arm for 6 mo, venous collaterals on left arm/CT scan and duplex ultrasound</td>
<td>Bilateral resection of clavicular heads; resolution of arm congestion and swelling, BCV patent at postoperative wk 6</td>
</tr>
<tr>
<td>Mirza et al</td>
<td>M/19</td>
<td>Rugby</td>
<td>Compression</td>
<td>Deformity and tenderness over left sternoclavicular joint/CT scan</td>
<td>ORIF using nonabsorbable suture</td>
</tr>
<tr>
<td>Bennett et al</td>
<td>M/20</td>
<td>Field hockey</td>
<td>Compression</td>
<td>Pain, swelling, elevated JVP, cyanosis of arm/CT scan, USG confirmed venous compression</td>
<td>ORIF using transarticular sutures with ligament repair</td>
</tr>
<tr>
<td>Buckley &amp; Hayden</td>
<td>M/16</td>
<td>Football</td>
<td>Partial compression</td>
<td>Pain and tenderness over left sternoclavicular joint/CT scan</td>
<td>Nonemergent open reduction without internal fixation</td>
</tr>
<tr>
<td>Hoekzema et al</td>
<td>M/41</td>
<td>Bull attack</td>
<td>Compression</td>
<td>Pain, right upper limb paresthesias, dyspnea/CT scan</td>
<td>ORIF using polydioxanone suture, ligament reconstruction</td>
</tr>
<tr>
<td>Kang et al</td>
<td>M/67</td>
<td>Machinery accident</td>
<td>Laceration of innominate vein–SCV junction</td>
<td>Pain, slight tracheal deviation, widened mediastinum/CT scan</td>
<td>Laceration repair using bovine pericardial patch, open reduction</td>
</tr>
<tr>
<td>Fenig et al</td>
<td>M/16</td>
<td>Wrestling</td>
<td>Laceration</td>
<td>Death due to right hemothorax/autopsy</td>
<td>N/A</td>
</tr>
<tr>
<td>Chotai &amp; Ebraheim</td>
<td>M/15</td>
<td>Wrestling</td>
<td>Compression</td>
<td>UEDVT, arm swelling, pain/duplex scan, CT scan</td>
<td>Open reduction without internal fixation; resolution of arm edema and pain</td>
</tr>
</tbody>
</table>

Abbreviations: AP, anteroposterior; BCV, brachiocephalic vein; CR, closed reduction; CT, computed tomography; JVP, jugular venous pressure; MVA, motor vehicle accident; N/A, not applicable; ORIF, open reduction and internal fixation; PSCD, posterior sternoclavicular dislocation; SCV, subclavian vein; UEDVT, upper-extremity deep vein thrombosis; USG, ultrasonography.
ate the vascular damage when a widened mediastinum is present.\textsuperscript{9,19} Magnetic resonance imaging is rarely necessary but may help determine ligament injuries and differentiate true posterior sternoclavicular dislocation from a physeal injury in young patients.\textsuperscript{1,22} Ultrasound examination satisfactorily visualizes the sternoclavicular joint and may diagnose a dislocation, especially in an unstable patient. It also helps detect vascular compression or mediastinal hematoma.\textsuperscript{29,32} Ultrasound examination of arm swelling may detect DVT of the arm veins and indicate brachiocephalic or subclavian venous compression, as in the current case. Rarely, bronchoscopy or esophagography may be performed to evaluate tracheal or esophageal compression, respectively.\textsuperscript{2,24}

**Management**

Management begins with clinical suspicion of injury and obtaining CT scans to confirm the diagnosis and rule out mediastinal injury. If posterior sternoclavicular dislocation is confirmed, vigilant monitoring of upper-extremity perfusion and neurological functions should be performed, and prompt reduction should be scheduled. A delay in reduction may lead to vascular compromise or thoracic outlet syndrome.\textsuperscript{1,5,6,19,20} Closed reduction is usually tried initially, especially in the absence of mediastinal injury and if presentation is within 48 hours of injury. However, closed reduction has been performed successfully as late as 7 to 10 days after injury.\textsuperscript{8,13,14} In a few cases, a blind attempt at closed reduction may release the tamponade effect on great vessels and could be catastrophic.\textsuperscript{21,30} Also, a risk of vascular tear or tracheal and/or esophageal perforation exists; hence, reduction should be performed under general anesthesia with cardiothoracic surgery backup.\textsuperscript{1,11,21}

The most popular technique is the abduction–traction technique, where the patient is positioned supine with a sandbag placed between the shoulders. The arm is abducted to 90°, and traction is applied with gentle extension of the arm. At this point, the medial end of the clavicle is reduced with a pop. If this fails, the medial clavicle is grasped using a towel clip and pulled anteriorly into anatomic reduction under sterile precautions.\textsuperscript{15} Alternatively, the patient is positioned supine with the arm in adduction; traction is applied to the arm caudally while anteroposterior pressure is applied to the shoulders bilaterally to achieve sternoclavicular joint reduction.\textsuperscript{3}

Cases with suspected or proven mediastinal injury or cases with delayed presentation or diagnosis require open reduction and internal fixation.\textsuperscript{1,9,11,16} A horizontal incision placed parallel to the shaft of the clavicle adequately exposes the sternoclavicular joint and medial clavicular metaphysis. Care should be taken to preserve as much anterior capsule as possible. The posteriorly dislocated clavicle can then be reduced back under direct vision. Postreduction, the stability of the joint should be determined on palpation or using a towel clip. The sternoclavicular joint is usually stable after reduction, and no internal fixation is required.\textsuperscript{1,11,14,15} However, if the joint is unstable or subluxates after reduction, internal fixation is necessary to prevent redislocation.

Numerous stabilization methods have been described.\textsuperscript{1,7,33} Commonly, a costoclavicular cerclage with a nonabsorbable suture or a semitendinosus graft tied in a figure-8 fashion is used to stabilize the reduction.\textsuperscript{1,33} Costoclavicular tenodesis using the subclavious muscle and sternoclavicular tenodesis using the sternal head of the sternocleidomastoid muscle have also been described.\textsuperscript{27} While stabilizing the joint, it is important to avoid injury to the joint surfaces and to the physis in young patients. In all instances, metal implants, including cannulated screws and K-wires, should not be used.\textsuperscript{34} Costoclavicular ligaments should not be damaged and, if ruptured, must be repaired before closure.\textsuperscript{7,11} In cases where the anterior capsular ligament is injured or exposure to underlying vasculature is inadequate and in cases with a subacute or chronic presentation, resection of the medial 1 to 1.5 inches of clavicle is indicated. The medial clavicle is then secured to the first rib through the costoclavicular ligament.\textsuperscript{21,23,24} This decompresses any mediastinal compression; however, it will not preserve the sternoclavicular joint. Postoperatively, a repeat CT scan is obtained to confirm adequate reduction and rule out subluxation. Rehabilitation of these patients is guarded, and patients should be immobilized in an arm sling for at least 6 weeks to allow for ligament healing, followed by gradual mobilization exercises.

**Conclusion**

Posterior sternoclavicular dislocation is a rare injury and may present with variable mediastinal compression symptoms. In a patient presenting after a fall or trauma to the shoulder, the presence of arm swelling and pain should raise suspicion for DVT secondary to venous compression posterior to the sternoclavicular joint. Plain radiographs often fail to diagnose the injury, and immediate CT scans should be obtained. If posterior sternoclavicular dislocation with vascular injury is confirmed, the patient should undergo surgery at the earliest opportunity to prevent further complications. All physicians dealing with trauma patients should be aware of this presentation for posterior sternoclavicular dislocation.

**References**

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