Pectoralis minor obstruction of the axillary vein: Report of six patients

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Purpose: Although the usual site of nonthrombotic venous obstruction of the upper extremity is the subclavian vein, other sites may be the cause of such obstruction. This study describes the diagnosis and treatment of six patients with partial axillary vein obstruction by the pectoralis minor muscle, a condition that can mimic subclavian vein obstruction.

Methods: A chart review of patients undergoing pectoralis minor tenotomies (PMT) between 2004 and 2006 revealed six patients (3 men and 3 women), aged 17 to 39, who underwent seven PMT procedures for symptoms of arm swelling, cyanosis, and pain or tightness. Diagnosis was suggested by history and physical examination and was confirmed by dynamic venography. Patients with paresthesia suggesting associated neurogenic pectoralis minor compression were given a pectoralis minor muscle block. As an outpatient, PMT was initially performed with an infraclavicular approach but later through the transaxillary route. Follow-up was by phone interview in five patients and a physical examination in one.

Results: Venography demonstrated axillary vein compression under the pectoralis minor, which was more significant than the minor degree of subclavian vein compression seen on the same venogram. Follow-up was 1.5 years to 10 years in three patients and 3 months in the other three. All six patients experienced good-to-excellent relief of all symptoms. There were no surgical complications.

Conclusion: Axillary venous obstruction by the pectoralis minor must be distinguished from subclavian vein obstruction, which presents with similar symptoms. PMT is a simple, risk-free, outpatient procedure that has produced uniformly good results. (J Vasc Surg 2007;45:1206-11.)

Pectoralis minor syndrome (PMS) is a rare diagnosis, and venous obstruction by the pectoralis minor (PM) muscle is even more obscure. Our attention was drawn to this condition by two patients, each of whom underwent three operations to decompress the subclavian vein in the thoracic outlet area without improvement. The first one was explored for the fourth time to dissect free the axillary vein and remove the adipose tissue around it. During the operation, it was necessary to divide the PM. The operation gave good relief of symptoms, which has lasted for over 10 years.

However, it did not dawn on us that it probably was the pectoralis minor tenotomy (PMT) that helped him until a second similar case appeared. This was an 18-year-old weight lifter. His first operation was a scalenotomy, his second a transaxillary first rib resection, and his third an infraclavicular resection of the remaining anterior portion of the first rib. None of these procedures helped. Dynamic venography was then performed by real-time imaging while both injecting dye and abducting the arm to 180°. This caught the dye temporarily being held up under the PM and removing the adipose tissue around it. During the operation, it was necessary to divide the PM. The operation gave good relief of symptoms, which has lasted for over 10 years.

We then recalled the first case of 10 years earlier and began paying closer attention to patients presenting with arm swelling, cyanosis, and pain. In the next 2 years, we recognized four more patients with axillary vein, non-thrombotic obstruction by the PM. This report describes the presentation of these patients, the role of venography in diagnosis, and the treatment by PMT, because axillary vein obstruction should be another consideration in patients who present with arms that are swollen, blue, and painful.

MATERIAL AND METHODS

This was a retrospective chart review of patients who underwent PMT to select those who had axillary vein compression. Six patients presented with arm swelling, cyanosis, and pain or tightness. The symptoms were chronic in five patients, being present from 1 to 5 years; the sixth patient had an acute onset and was initially seen 1 day after the onset of symptoms. In all patients, the symptoms were present at rest and aggravated by arm elevation or exercise.

Diagnosis was suggested by history, physical examination, and confirmed by venography. A PM block was also performed in three of the patients, one of whom was bilateral and also had symptoms of neurogenic pectoralis minor syndrome (PMS).

Pectoralis minor block. A PM block was performed in patients with chest pain and hand paresthesia and symptoms of venous obstruction by injecting 4 mL of 1% procaine into the PM tendon area, moving the needle every 0.5 mL. A 1.5-inch No. 22 needle was aimed cephalad at a 45° angle pointing toward the coracoid process. The point of entrance was 3 cm below the clavicle and near the most tender point detected on physical examination. Needle aspiration was always done each time the needle was advanced to prevent injection into a major vessel. A good

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response was noted by reduction in symptoms at rest plus improvement in the positive findings that had been present just before the block.

Venography. In some patients, diagnosis began with a duplex scan revealing a patent axillary-subclavian vein. However, dynamic venography was performed in all patients, filming with the arm at rest, abducted to 90°, and then 180°. One patient was filmed as the dye was injected while the arm was moving in abduction (Fig 1). Venography was performed through a needle inserted into the basilic vein above the elbow. Ultrasound imaging was often used to locate the vein. For each run, 20 to 40 mL of contrast was injected.

Four patients with nonthrombotic venous obstruction, where venography revealed narrowing of >50% at both axillary and subclavian veins, were excluded because they received surgical decompression of both the PM and thoracic outlet areas, and it impossible to distinguish the role of PM decompression alone.

Surgical procedure. Outpatient surgery was performed under endotracheal anesthesia. An 8-cm to 9-cm infraclavicular incision, 3 cm below the center of the clavicle, was used in the first two patients. The pectoralis major muscle was split in the direction of its fibers to expose the PM. In the next four patients, a 6-cm to 9-cm transaxillary incision was made 1 cm above the bottom of the hairline.

Fig 1. A, B, and C, A preoperative venogram demonstrates temporary axillary vein obstruction by the pectoralis minor muscle. Films are 1 second apart. The arrow indicates the axillary vein. B, Note collaterals, but no filling of the axillary-subclavian vein. C, The axillary-subclavian vein has filled and collaterals are still visible. D, Postoperative venogram of the same patient shows the axillary vein is wide open without collaterals.
This incision was 1 to 2 cm higher than is used for transaxillary rib resection. We have found the higher incision provides better exposure of the coracoid process.

After limited dissection of subcutaneous fat, the pectoralis major muscle was identified and followed deep to find the PM at its insertion into the coracoid process. Blunt dissection with a peanut dissector and index finger proved to be the best instruments. The PM tendon was divided at its insertion into the coracoid process. The upper limb tension test (ULTT) of Elvey was positive in three of five extremities, confirming associated compression of nerves of the brachial plexus. The ULTT test is comparable to straight leg-raising in the lower extremity. It stretches the brachial plexus in four steps: (1) elevating the arm to 90° with the elbow flexed 90°, (2) straightening the elbow, (3) dorsiflexing the wrist, (4) and tilting the head to the contralateral side. A positive response is pain or paresthesia in the arm or hand in any of these positions which in turn indicates nerve or nerve root compression in the neck, thoracic outlet, or pectoralis minor area.

**Physical examination.** No single physical finding was present in all patients except tenderness, and that was not always in the same spot (Table II). Arm circumference was measured over the largest portion of the biceps. It was 1 to 2 cm larger in all but one patient, in whom the circumference was 4 cm larger in the affected limb than the normal limb.

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**Venography.** Dynamic venography demonstrated various degrees of axillary vein narrowing in all patients.

Quantitative measurements were available in five patients, and revealed total occlusion in two, and 40%, 50%, and 70% occlusion in the other three (Fig 1 and Fig 2). Three patients underwent postoperative venography, and in two, all stenosis was gone. In the third, stenosis was slightly reduced from 50% to 40%, but despite the residual, this patient had excellent relief of her symptoms. Perhaps an explanation for this minimal change is that unlike arteriography, venography of the axillary vein may sometimes reveal spasm, for unknown reasons. We have seen this in other patients.

**Pectoralis minor block.** The PM block is a test for neurogenic pectoralis minor compression. The block gave a positive response in three of the four instances in which it was performed.

**Surgical observations.** In each case, the PM was always found resting on top of the axillary vein. In addition, branches of the brachial plexus were seen surrounding the vein and artery. The PM was in contact with some of these

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**Table I.** Common symptoms of patients presenting with pectoralis minor obstruction of the axillary vein

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Patients asked about symptoms, n</th>
<th>Patients with positive response, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain or tightness</td>
<td>7</td>
<td>4 (57)</td>
</tr>
<tr>
<td>Neck</td>
<td>7</td>
<td>4 (57)</td>
</tr>
<tr>
<td>Supraclavicular area</td>
<td>7</td>
<td>4 (57)</td>
</tr>
<tr>
<td>Trapezius</td>
<td>7</td>
<td>4 (57)</td>
</tr>
<tr>
<td>Anterior chest wall</td>
<td>7</td>
<td>6 (86)</td>
</tr>
<tr>
<td>Shoulder</td>
<td>7</td>
<td>5 (71)</td>
</tr>
<tr>
<td>Arm</td>
<td>7</td>
<td>6 (100)</td>
</tr>
<tr>
<td>Weakness</td>
<td>6</td>
<td>7 (100)</td>
</tr>
<tr>
<td>Swelling</td>
<td>7</td>
<td>5 (71)</td>
</tr>
<tr>
<td>Cyanosis</td>
<td>7</td>
<td>7 (100)</td>
</tr>
<tr>
<td>Paresthesia</td>
<td>7</td>
<td>5 (71)</td>
</tr>
</tbody>
</table>

**Table II.** Physical findings

<table>
<thead>
<tr>
<th>Examination</th>
<th>Patients tested, n</th>
<th>Positive response, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalenal tenderness</td>
<td>7</td>
<td>4 (57)</td>
</tr>
<tr>
<td>Pectoralis minor tenderness</td>
<td>6</td>
<td>5 (83)</td>
</tr>
<tr>
<td>Axillary tenderness</td>
<td>5</td>
<td>3 (60)</td>
</tr>
<tr>
<td>ULTT</td>
<td>5</td>
<td>3 (60)</td>
</tr>
<tr>
<td>Pectoralis minor block</td>
<td>4</td>
<td>3 (75)</td>
</tr>
<tr>
<td>Arm diameter increased 0.5-4 cm</td>
<td>5</td>
<td>4 (80)</td>
</tr>
</tbody>
</table>

**ULTT,** Upper limb tension test of Elvey.

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**RESULTS**

**Patients.** There were seven operations on six patients (3 men, 3 women) aged 17 to 39 years. One operation was bilateral. Three of the six patients gave a history of an auto accident before the onset of symptoms, including the one bilateral patient. One patient was a weight lifter, and one was a construction worker. The sixth patient had a spontaneous onset. Three of the six patients had previously undergone transaxillary first rib resections.

**Symptoms.** Symptoms were on the right side in three patients and on the left side in four (one patient was bilateral). Swelling and weakness were the only symptoms present in all patients. Cyanosis, paresthesia, and shoulder pain or tightness, was present in most. Other common symptoms are listed in Table I. Swelling was expressed as mild. Pain was not severe and was usually described as an ache or tightness. In addition to signs of mild venous obstruction, all patients had some symptoms of nerve irritation such as paresthesia. However, none had symptoms of arterial involvement, such as pallor, ischemia, or claudication.

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**Follow-up.** By periodic examination in one patient and by telephone in the other five. Three of these five patients lived out of state, and two lived locally but were lost to follow-up at 3 months. One moved to another state, and the other died in an automobile accident.

**Operative time was 30 to 35 minutes. Postoperatively, patients were instructed on home exercises of wall climbing with their fingers to achieve full shoulder abduction within 3 to 4 days. There were no complications.**

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**Surgical observations.** In each case, the PM was always found resting on top of the axillary vein. In addition, branches of the brachial plexus were seen surrounding the vein and artery. The PM was in contact with some of these branches of the brachial plexus were seen surrounding the vein and artery. The PM was in contact with some of these...
nerve branches, but in no consistent pattern. It was not possible to identify any of the individual nerve branches by name because the cords of the plexus were proximal to the area of exposure and not dissected out.

**Arm swelling.** The difference in arm diameter was reduced from 4 to 1 cm in the one patient in whom it was measured postoperatively. The other patients were not available for postoperative measurements.

**Success rate.** Three patients were followed up from 1.5 to 10 years; the other three were followed up for only 3 months. Subjectively, significant improvement in symptoms was reported in all seven extremities in the six patients. Pain, tightness, and cyanosis as well as neurologic symptoms of weakness and paresthesia were greatly reduced or eliminated in every patient.

**DISCUSSION**

In 1945, Wright introduced the term pectoralis minor syndrome as a “neurovascular syndrome produced by hyperabduction of the arms.” That article focused primarily on the axillary artery, pointing out that in >80% of normal controls, the radial pulses were obliterated when their arms were elevated overhead. He did mention axillary vein involvement and suggested that, “venographic studies will doubtless be of interest.” He was exactly right.

Lord and Stone, in 1956, were first to report five patients undergoing PM division along with scalenotomy to treat “hyperabduction syndrome.” Three of these patients had typical symptoms of arm pain or tightness plus mild arm swelling. Although surgery relieved the pain, the swelling persisted unchanged. Venography was not performed at that time, and because the swelling persisted, it is possible that some of those patients had subclavian vein obstruction rather than axillary vein obstruction.

**Etiology.** Compared with nonthrombotic subclavian vein obstruction, axillary vein obstruction has rarely been recognized, with only four individual cases reported to date. Although some anatomic causes for obstructing the subclavian vein are now recognized in many patients, namely compression by the costoclavicular ligament and subclavius tendon plus excessive arm activity, no such anatomic predisposition or activity has yet been recognized for axillary vein obstruction. At operation in this study, there were no unusual anatomic anomalies or variations, although in one patient there was a thickened band of clavipectoral fascia lying next to the PM. However, among our small group of patients, five of the six had a history of some type of activity that could stretch the PM by excessive traction on the scapula, namely auto accidents, weight lifting, and working construction. Although this is not clear cause and effect, it is an observation that needs consideration.

**Clinical picture.** The primary symptoms of axillary vein obstruction are swelling, pain, and cyanosis. All of our patients, however, had additional symptoms of neurogenic compression, with weakness and paresthesia being most common. This is not surprising, because the anatomic structure of the axillary neurovascular bundle is such that some branches of the brachial plexus lie on top of the axillary vein so they are in closer contact with the PM than the vein. Thus, pressure on the vein will often be accompanied by pressure on the nerves (Fig 3). In contrast, the artery usually lies deep in the bundle, away from the PM, which explains why it is rarely involved.

Physical findings are mild and subtle. Arm swelling is usually minimal compared with the larger swelling often seen with venous thrombosis. Tenderness is often present.
over the PM tendon and the anterior scalene muscle. Color changes of dark blue or red may be seen in the hand or arm.

**Subclavian vein obstruction.** It is not easy to distinguish venous obstruction of the axillary vein from that of the subclavian vein because their symptoms are virtually the same. One vein is simply the continuation of the other, the distinction being that when the axillary vein crosses the first rib, it changes its name to subclavian. However, it is usually possible—and quite important—to distinguish the point of obstruction between the two veins because surgical decompression of the axillary vein is much easier.

In the presence of both subclavian and axillary vein stenosis, the transaxillary approach permits both PMT and first rib resection with subclavian venolysis through the same incision. In situations where it is questionable whether subclavian vein stenosis is accompanied by significant axillary vein compression, our current approach is to always include PMT with first rib resection. This actually facilitates exposure of the first rib, and there is no increased morbidity.

**Duplex scanning.** Although duplex scanning can detect the point of venous thrombosis fairly well, it is too insensitive to detect subtle degrees of venous compression without total occlusion. The most helpful diagnostic tool is dynamic venography.

**CONCLUSION**

In patients presenting with arm swelling, cyanosis, and pain, it is important to differentiate, by dynamic venography, obstruction of the subclavian vein from obstruction of the axillary vein. Axillary vein obstruction by a tight PM is a distinct entity easily treated by PMT in an outpatient operation. This procedure is both simpler and less morbid than first rib resection. Recovery is rapid, and scarring is minimal. Although this study contains only seven operations and follow-up was <2 years in all but one patient, the results to date have been very encouraging.

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**AUTHOR CONTRIBUTIONS**

Conception and design: RS
Analysis and interpretation: RS, NR
Data collection: RS, NR
Writing the article: RS, NR
Critical revision of the article: RS
Final approval of the article: RS, NR
Statistical analysis: Not applicable
Obtained funding: Not applicable
Overall responsibility: RS

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