Clavicle fractures are common; however, complications are unusual. Two such complications, subclavian artery pseudoaneurysm and brachial plexopathy, are rare events that can cause significant morbidity and mortality. We report the case of a 53-year-old man who presented with shoulder swelling and right arm weakness for 1 week. Three weeks before, he had fallen and fractured his right clavicle. On presentation to our emergency department, his examination revealed a brachial plexopathy and a large supraclavicular mass. An emergency bedside triplex sonogram was performed to characterize the mass and revealed a swirling pattern within a fluid collection anterior to the subclavian artery, suggestive of a pseudoaneurysm. After computed tomography–angiography, the patient was taken to the operating room, where he underwent hematoma washout and subclavian artery stent-graft placement. This case illustrates how bedside point-of-care sonography can rapidly assist in the initial assessment of subclavian artery injury. [Ann Emerg Med. 2013;61:204-206.]

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INTRODUCTION

Clavicle fractures account for up to 12% of all fractures.\(^1\) Complications, such as subclavian artery pseudoaneurysm and brachial plexopathy, are uncommon and may be delayed by weeks to months. Pseudoaneurysm is traditionally diagnosed by digital subtraction angiography or computed tomography (CT) angiography and more recently by color and spectral Doppler sonography. This article describes the diagnostic approach and technique for performing bedside sonography to rapidly assess for subclavian artery injury and thus expedite radiographic studies and management.

CASE REPORT

A 53-year-old man presented to the emergency department (ED) for a right shoulder injury sustained 3 weeks before from a ground-level fall. His primary care physician diagnosed a displaced distal right clavicle fracture by radiograph and treated him with a simple sling. One week before presentation to the ED, he noticed increased swelling, pain, and bruising around the injured shoulder, extending toward the right side of the upper chest, neck, and thorax; and numbness, swelling, and weakness in his right hand and arm. He was referred for magnetic resonance imaging (MRI). Because of inability to tolerate a supine position for MRI, he was brought to this ED for further evaluation.

The patient’s medical history was significant for gout and hypertension. Medications included indomethacin, allopurinol, and aspirin. Initial vital signs included a blood pressure of 150/90 mm Hg, pulse rate 107 beats/min, respirations 20 breaths/ min, temperature 36.1°C (97°F), and oxygen saturation 99% on room air. On examination, he appeared uncomfortable, having to lean over a chair to minimize the shoulder pain. Lungs were clear to auscultation. Cardiac examination was significant for mild tachycardia. There was a large, tense, nonpulsatile mass in the right supraclavicular space (Figure 1). Marked tenderness to palpation was observed over the distal clavicle, along with purpuric ecchymosis extending from the supraclavicular region to the right posterolateral thorax. Diffuse edema was present in the entire right upper extremity. The right hand was warm, with brisk capillary refill in all fingers. Radial and ulnar pulses were 2+ and equal. Neurologic examination was significant for 0/5 strength in all muscle groups of the right upper extremity, with the exception of minimal (1/5) thumb opposition and finger flexion. Sensation was diminished to light touch, pinprick, and temperature in median, ulnar, and radial distributions. Deep tendon reflexes in the right upper extremity were absent.

Chest radiography revealed clear lungs, no pneumothorax or effusions, a displaced fracture of the distal third of the clavicle, and a large supraclavicular soft tissue mass. Emergency bedside sonography was performed to characterize the mass (SonoSite M-Turbo, Bothell, WA). To optimize visualization of the right subclavian artery, the patient was positioned supine with his head slightly turned to the contralateral side and the right arm passively supinated and slightly abducted. A high-frequency, 6- to 12-MHz, linear transducer was initially placed over the supraclavicular region in the coronal oblique plane, using conventional B-mode imaging. The B scan sonogram demonstrated an 8×10-cm fluid-filled mass with a hyperechoic swirling pattern. A low-frequency 1- to 5-MHz sector...
transducer was then used to allow for an increase in depth and field of view. Color Doppler over the mass revealed a swirling pattern of blood flow commonly referred to as the yin-yang sign (Figure 2A). Spectral Doppler within the cavity lumen indicated turbulent arterial flow (Figure 2B), but a pseudoaneurysmal neck could not be identified to its communicating source, likely because of the large size of the mass.

Because a pseudoaneurysmal neck and the subclavian artery were not identified on sonography, and to help with planning of surgical treatment, a multidetector CT angiogram of the neck with 2-dimensional reformations was obtained. This revealed a 9.6×8.4×11.7-cm (anteroposterior×transverse×craniocaudal) fluid collection adjacent to the clavicle fracture and supraclavicular fossa, with severe compression and inferior displacement of the right subclavian artery and vein. A site of active hemorrhage was not identified. The patient was taken immediately to the operating room, where he underwent incision and manual evacuation of hematoma. After hematoma washout, ongoing bleeding was observed from the region of the distal subclavian. Intraoperative arteriography performed after washout demonstrated active extravasation from the distal subclavian artery. Endovascular exclusion of what was believed by the vascular surgeon to be a pseudoaneurysm was obtained with 2 Viabahn stent-grafts. Pneumonia, sepsis, and gastrointestinal bleeding complicated the patient’s postoperative course. He was discharged from the hospital on postoperative day 20.

**DISCUSSION**

Complications of clavicle fracture include nonunion, malunion, brachial plexus injury, and pneumothorax and vascular injuries, including pseudoaneurysm. Although rare, the complications found in our patient have been described in the literature. This discussion thus focuses on the diagnostic approach to suspected subclavian artery injury using bedside sonography.

Subclavian artery injuries after clavicle fracture occur after penetrating and blunt trauma, with the latter accounting for about 2% to 3% of these injuries. Pseudoaneurysm results from a tear or puncture through all layers of the artery, allowing blood to dissect into the soft tissues around the artery and form a cavity that communicates with the lumen of the damaged artery. Two components are usually present with the pseudoaneurysm: the sac or cavity and a neck by which the sac communicates with the vessel lumen.

Digital subtraction angiography is the traditional standard for diagnosis of pseudoaneurysm and planning treatment but is invasive, uses ionizing radiation and iodinated contrast material,
has a risk of procedural complications, and is typically performed outside of the ED. It is used most commonly after the diagnosis of pseudoaneurysm has been made by sonogram or multidetector CT angiography, typically in conjunction with endovascular or surgical intervention. Triplex sonography, including grayscale, color Doppler, and spectral Doppler, is a rapid, noninvasive method to diagnose pseudoaneurysms that can be performed at the bedside. It is relatively inexpensive and does not require ionizing radiation or renal toxic contrast material. Duplex sonography (grayscale and color Doppler) has been shown to have a sensitivity and specificity of 94% and 94% to 97%, respectively, in diagnosing postcatheterization aneurysms. Bedside sonography has been reported as a means to diagnose radial artery pseudoaneurysm caused by penetrating trauma. For readily accessible pseudoaneurysms of the radial or temporal artery, sonography may be the only diagnostic test needed to evaluate for pseudoaneurysm before definitive, ultrasonographically guided treatment.

A pseudoaneurysm has 3 characteristic findings on sonography, although their absence does not exclude the presence of pseudoaneurysm: (1) a fluid-filled structure seen on grayscale adjacent to a supplying artery and which may have variable echogenicity; (2) pulsatility with bidirectional flow (“to and fro” sign); and (3) the detection of swirling, turbulent blood flow within the pseudoaneurysmal cavity, creating a yin-yang sign on color Doppler, which resembles the ancient Chinese yin-yang symbol.

Grayscale sonography is usually performed first in the evaluation for possible pseudoaneurysm, using the highest-frequency linear transducer that will allow good depth penetration. A cystic or round mass adjacent to the artery at the puncture site will be found and may appear to compress the adjacent artery or vein. Grayscale sonography is useful for determining the size of a pseudoaneurysmal sac, determining the number of lobes or compartments within, identifying a connection of the sac to the artery, and measuring the length and width of the neck. By itself, grayscale is not diagnostic of pseudoaneurysm because similar findings can be present with simple cysts or hematomas.

Color Doppler is next used to detect flow. One color represents flow toward the transducer and another color represents flow away from it. The red and blue yin-yang sign observed with pseudoaneurysm results from the swirling of blood overlying opposite walls of the pseudoaneurysmal cavity. This sign may also be observed with saccular and fusiform aneurysms.

Spectral Doppler is used to characterize arterial versus venous flow. The to-and-fro sign on spectral waveform represents a cyclical, biphasic change in direction of blood flow in and out of a pseudoaneurysm with systole and diastole. During systole, the higher pressure on the arterial side causes blood flow into the pseudoaneurysm sac. During diastole, there is reversal of flow from the pseudoaneurysmal sac to the communicating artery because of relative higher pressure within the distended sac and recoil with decreased diastolic arterial pressure. These findings can also be observed with hematomas because of transmission of pulsations from the underlying artery, and to our knowledge there are no studies that evaluate the sensitivity or specificity of this sign.

Our case report demonstrates the value of point-of-care sonography to rapidly assess for possible vascular injury, thus expediting additional radiographic studies and surgical management. In the appropriate clinical context, a definitive diagnosis of pseudoaneurysm can be made by the sonographic demonstration of a neck communicating from the injured artery to the pseudoaneurysmal sac, together with a to-and-fro spectral waveform pattern within the neck. The presence of other sonographic features characteristic but not diagnostic of pseudoaneurysm should prompt additional evaluation and treatment planning with multidetector CT angiography, magnetic resonance angiography, or digital subtraction angiography.

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