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Case Report

Ultrasound-guided percutaneous coil and thrombin embolization of a left gastric artery pseudoaneurysm ☆

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ABSTRACT

Pseudoaneurysms are a commonly encountered pathology, though pseudoaneurysms of the visceral arteries are a less frequent, but potentially deadly entity. Transarterial embolization is the typical treatment of visceral pseudoaneurysms, but success is dependent on anatomy that is conducive to selecting the supplying vessel. Abdominal ultrasound is a viable method to effectively treat visceral pseudoaneurysms when transarterial embolization is not possible. It is also an excellent example of the growing utilization of ultrasound guidance in various interventional radiologic procedures. The usefulness of ultrasound is demonstrated in this case report, where a left gastric artery pseudoaneurysm was embolized through ultrasound guidance.

Introduction

The arterial wall is composed of 3 layers, with the innermost to outermost layers being the tunica intima, tunica media, and tunica adventitia. True aneurysms occur following injury to the arterial wall and involve outpouching of all 3 layers [1]. Pseudoaneurysms cause outpouching of less than 3 layers of the arterial wall and are usually bound by the tunica adventitia [1]. When the blood vessel is injured, active arterial bleeding will cause pooling of blood in the pseudoaneurysm sac.

Visceral pseudoaneurysms are a rare complication of infection, trauma, neoplasm, inflammation, and surgery [2]. Visceral pseudoaneurysms most commonly involve the splenic (60%), hepatic (20%), superior mesenteric (5.5%), celiac (4%), gastric and gastroepiploic (4%), intestinal (3%), pancreaticoduodenal and pancreatic (2%), and gastroduodenal (1.5%) arteries [3]. Ruptured or bleeding pseudoaneurysms have a reported mortality rate of 25%-70% [4]. Symptoms of visceral pseudoaneurysms include abdominal pain, nausea, vomiting, and gastrointestinal bleeding, though most patients are asymptomatic [5]. Physical exam may reveal a painful,

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pulsatile mass, with bruit on auscultation of the pseudoaneurysm site [1]. Complications of pseudoaneurysms include ruptured or active bleeding which can lead to intra-abdominal hemorrhage, erosion and compression of adjacent structures, and hemosuccus pancreaticus [4,6]. Ruptured or bleeding pseudoaneurysms have a reported mortality rate of 25%-70% [4]. Transarterial embolization is the preferred method of treatment, but anatomic, equipment, and operator limitations can make this difficult to achieve [7]. This case describes a successful ultrasound-guided embolization of a left gastric artery pseudoaneurysm while effectively demonstrating the increasingly useful implementation of ultrasound as an alternative to ionizing radiation in many interventional radiologic procedures.

Case summary

A 94-year-old female patient with a history of hypertension, hyperlipidemia, atrial fibrillation, recent cerebrovascular accident, severe aortic stenosis, osteoarthritis, congestive heart failure with reduced ejection fraction, and transcatheter aortic valve replacement presented to the emergency department due to a few weeks of generalized weakness and intermittent left-sided facial pain. No other complaints were noted. Review of systems was negative. Physical exam findings included vital signs within normal limits and a one-sixth systolic murmur with occasional premature atrial and ventricular contractions. Neurologic exam was notable for dysarthria which began after her cerebrovascular accident, but no other focal neurologic deficits were present.

Notable labs included red blood cells (RBC) 2.53 million/mm^3 (reference range: 3.5-5.5 million/mm^3), hemoglobin 7.5 g/dL (reference range:12.0-16.0 g/dL), hematocrit 24.7% (reference range: 36%-46%), red blood cell distribution width 15.9% (reference range 11.6%-14.6%), albumin of 3.1 g/dL (reference range: 3.5-5.5 g/dL), international normalized ratio 1.39 (reference range: 0.8-1.1), alanine transaminase 8 U/L (reference range: 10-40 U/L), and total bilirubin of 2.2 mg/dL (reference range: 0.1-1.0 mg/dL). Imaging studies done at this time included a normal chest X-ray and a noncontrast head CT which showed chronic encephalomalacia and chronic small vessel ischemic changes.

The patient was diagnosed with severe anemia due to potential GI blood loss while on apixaban (Eliquis, Bristol-Myers Squibb Co., New York, NY), which prompted her admission. Her hemoglobin continued to drop, so she was given one unit of packed red blood cells, bringing her hemoglobin to 8.3 g/dL. To evaluate for gastrointestinal bleeding, a fecal occult blood was ordered, which was negative. Computed tomography (CT) of the abdomen was performed, revealing a 3.7 × 3.7 × 3.1 cm left gastric pseudoaneurysm with active arterial bleeding adjacent to the lesser curvature of the stomach (Fig. 1). The left gastric artery was found to originate directly from the aorta (Fig. 2). Additionally, a 5.7 × 3.1 cm hematoma was found in the gastrohepatic space, an 11.2 × 9.5 cm hematoma was found in the pelvis, and perisplenic fluid was present.

A mesenteric angiogram of the celiac trunk was performed, which demonstrated a markedly tortuous origin of both

Fig. 1 – Coronal CT abdomen pelvis with contrast. The imaging shows a 3.7 x 3.7 x 3.1 cm pseudoaneurysm (white arrow) with active arterial bleeding adjacent to the lesser curvature of the stomach (red arrow).

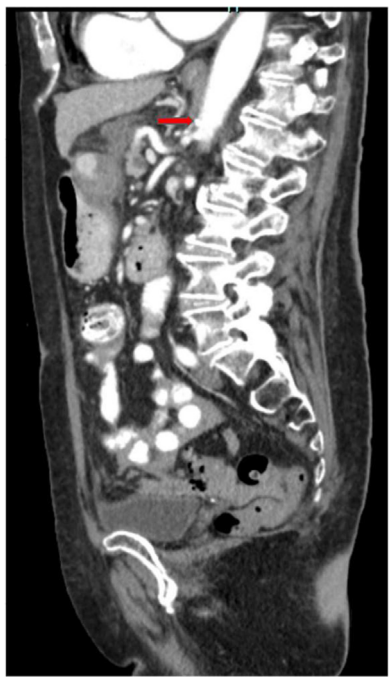

Fig. 2 – Sagittal CT abdomen pelvis with contrast. The red arrow indicates the aortic origin of the left gastric artery.

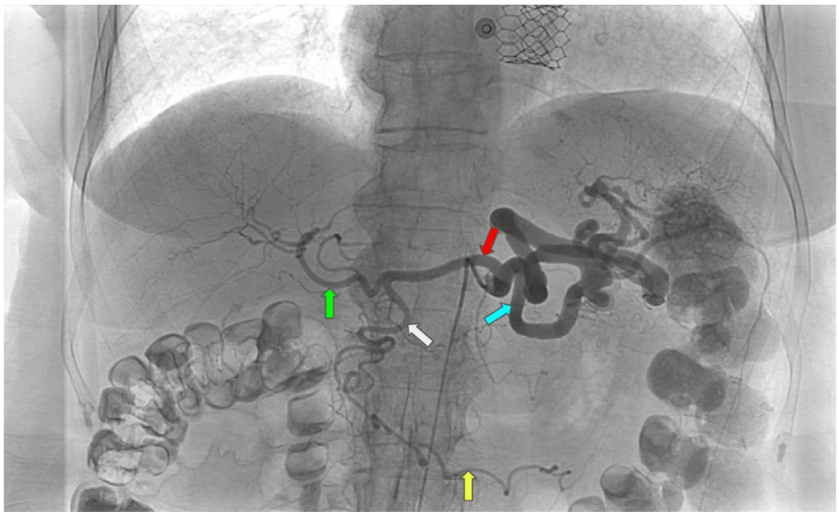

Fig. 3 – Mesenteric angiogram shows the tortuous origins of the common hepatic (red arrow) and splenic arteries (blue). The gastroduodenal (white), gastroepiploic (yellow), and proper hepatic (green) arteries are also visualized.

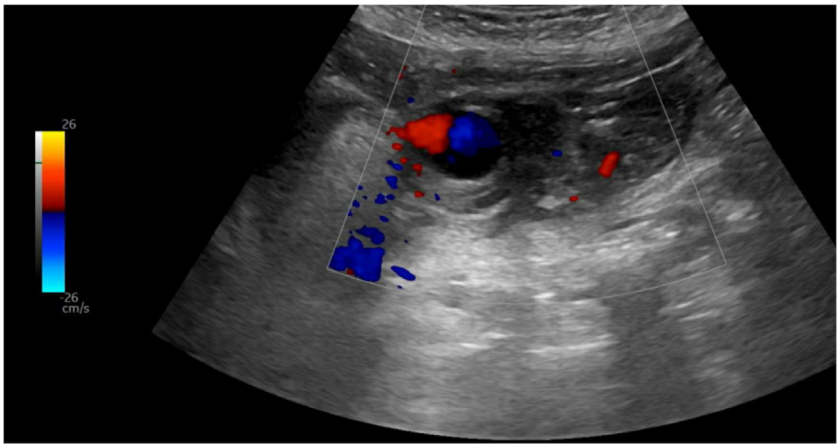

Fig. 4 – Transabdominal Doppler ultrasound showing pseudoaneurysm of the left gastric artery, "yin-yang" sign is present and represents the bidirectional flow through the neck of the pseudoaneurysm.

common hepatic and splenic arteries (Fig. 3). The origin of the common hepatic, gastroduodenal, right gastric, and gastroepiploic arteries were identified, but there was no evidence of active contrast extravasation or visualization of the pseudoaneurysm. The left gastric artery arising from the aorta was then identified, but unable to be selected. Due to prolonged procedure, use of multiple catheters, and inability to place the catheter in sufficient position for embolization, the procedure was ended and a repeat attempt was planned. The following day embolization was reattempted. Rather than a transarterial approach, the left gastric artery pseudoaneurysm was visualized with ultrasound (Fig. 4) and then punctured percutaneously, using an anterior single-wall micropuncture technique. A three-French Merit Maestro microcatheter (Merit Medical, South Jordan, UT) was placed in the pseudoaneurysm, and an angiogram visualized the pseudoaneurysm, retrograde filling of the patient's left gastric artery up to the level of the aorta, as well as filling of the hepatic artery (Fig. 5). Several Cook Nester micro-coils (Cook Medical, Bloomington, IN) were deployed through the microcatheter and thrombin was injected, successfully occluding the patient's pseudoaneurysm (Fig. 6). Microcoil embolization was chosen due to ease of control of microcoils compared to liquid embolics, and because of the lower risk of complications such as nontarget embolization, catheter trapping, and catheter fragmentation. A repeat CT angiogram (CTA) the next day confirmed successful embolization (Fig. 7). The patient had resolution of her symptoms with no postprocedural complications, was restarted on Eliquis, and was discharged 3 days after the procedure.

Discussion

There are a variety of imaging methods used to diagnose pseudoaneurysms. Cross-sectional CT is preferred to diagnose visceral pseudoaneurysms, as the lesion and inciting factor can

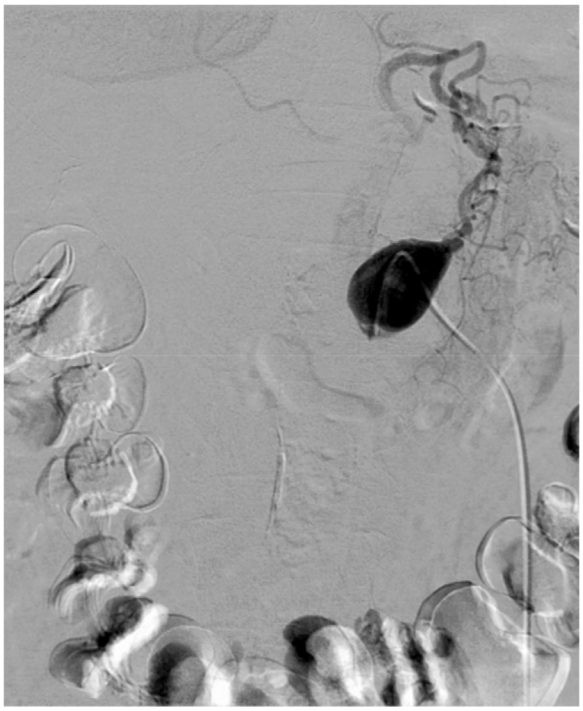

Fig. 5 – Digital subtraction angiography shows percutaneous puncture and contrast filling of the left gastric artery pseudoaneurysm. Retrograde filling of the aorta confirms the left gastric artery's aortic origin and patency.

be visualized. CTA in particular has become increasingly helpful in these situations, as technological improvement has led to the sensitivity and specificity of CTA nearing that of digital subtraction angiography [8]. Additionally, CTA is the gold-standard for treatment and follow-up of disease involving the abdominal arteries [8]. Multiphase scans aid in defining vascular anatomy and injury, and in identifying areas of contrast extravasation [8]. Multiplanar reconstruction and 3D images further strengthen the use of CTA in preprocedural planning by providing essential anatomic information needed to choose between endovascular and surgical treatments [8].

Ultrasound is also known to be a useful tool in the diagnosis of left gastric artery pseudoaneurysm, with sonographic findings showing a hypoechoic lesion around the lesser curvature of the stomach [4]. Doppler ultrasound can have a variety of findings characteristic of pseudoaneurysms. The color flow imaging will show a swirling pattern in the false lumen, described as "yin-yang" sign, which is shown in Fig. 4 [9]. This pattern is caused by bidirectional flow through the neck of the pseudoaneurysm. During systole, a powerful inflow will enter the pseudoaneurysm, while also creating backward flow away from the ultrasound transducer [9]. During diastole, the direction of flow will invert due to the decrease in arterial blood pressure [9]. Spectral analysis, which refers to the graphical representation of flow velocity over time, would produce a "to-and-fro" waveform, which is also indicative of bidirectional flow at the neck of the pseudoaneurysm [9]. Studies have shown that these findings are best visualized by using

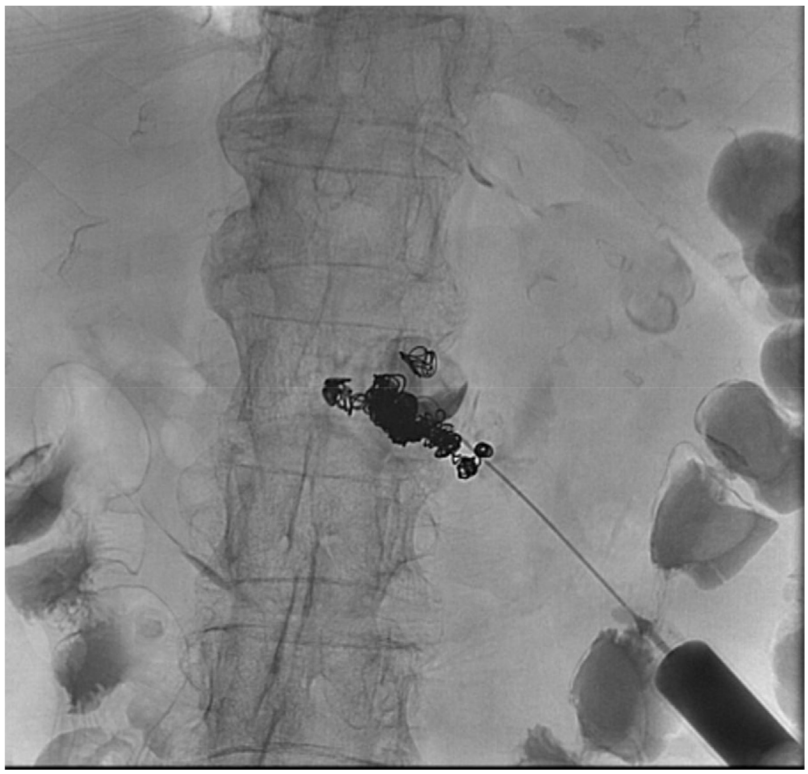

Fig. 6 – Angiography at the end of the procedure shows microcoils occluding the pseudoaneurysm. The 2 microcoils seen farthest to the right in this image were likely deployed outside of the lesion. Contrast partially fills the pseudoaneurysm sac with no signs of extravasation through the coils into the left gastric artery.

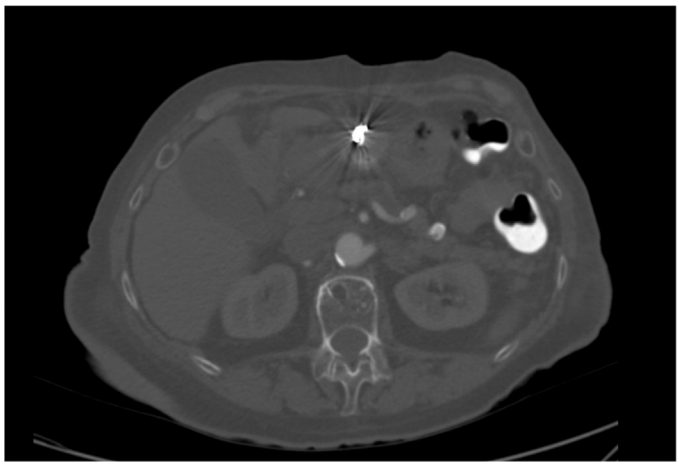

Fig. 7 – CT angiogram 1-day postprocedure shows enhancement representing the coil pack in the pseudoaneurysm. Contrast administration showed no evidence of extravasation or continued blood flow into the pseudoaneurysm.

the lowest pulse repetition frequency (2000-2500 Hz), lowest level of color gain (150-350 Hz), and by keeping the color box as small as possible [9]. Contrast-enhanced ultrasound, which uses gas filled microbubbles as a contrast agent to provide a real time depiction of vasculature and active bleeding is a more recent innovation that can effectively detect pseudoaneurysms [10]. This modality is still gaining traction and is not part of any standardized imaging protocols, but is well received due to its ability to detect blood signal without the use of iodinated contrast or ionizing radiation [10]. Though ultrasound has many capabilities in detecting pseudoaneurysms, its usefulness becomes limited in patients with large body habitus and meteorism of the bowel. Ultrasound beams are directly attenuated by fat, which causes a decrease in image quality as the ultrasound beam must travel through more tissue to reach the internal organs in an obese patient when compared to a nonobese patient. Air in the bowel can lead to a significant impedance mismatch, creating an irregular, hyperechoic image with reverberation artifacts, which ultimately degrades image quality and obscures anatomical structures [11].

Treatment of visceral pseudoaneurysm has evolved greatly. Previously, surgical interventions such as aneurysmectomy or ligation were used but fell out of favor due to high mortality and complication rates [2,4]. Transarterial embolization is now preferred due to the ability to more precisely localize the lesion and assess collateral flow [4]. Studies have reported an 85% success rate and lower complication rates when compared to surgery [6]. In the case presented, transarterial embolization was unsuccessfully attempted due to the inability to visualize the pseudoaneurysm and its arterial supply. The left gastric artery was suspected because of the location of the pseudoaneurysm in the lesser curvature of the stomach. The left gastric artery was patent on CT, so the most likely reason for failed mesenteric angiogram was either related to challenging anatomy of the left gastric artery, or placement of the catheter distal to the aortic origin of the left gastric artery. Following unsuccessful transarterial embolization, CT and sonographic guidance techniques were considered. The pseudoaneurysm was easily visualized sonographically, so this approach was chosen for reattempting embolization.

An ultrasound-guided percutaneous approach is a less common, but not unheard-of technique for the treatment of visceral pseudoaneurysms. This technique was successfully utilized in peripheral vessels priorly, with a reported success rate of 96% and complication rate of 2% in patients with iatrogenic femoral pseduoaneurysms [12]. This technique has since been applied to visceral pseudoaneurysms that were unable to be accessed transarterially due to vessel size, length, tortuosity, or the presence of a short pseudoaneurysm neck [4,6,13]. It has been demonstrated to be a safe procedure, though the most dangerous complications include hemorrhage, pseudoaneurysm reperfusion through retrograde filling or collaterals, coil migration, propagation of distal emboli, and thrombosis of native vessels [4,14]. Temporary headache, hypotension, and pain are less severe side effects related to thrombin injection [4]. Our patient's procedure was uncomplicated and follow-up imaging showed complete pseudoaneurysm occlusion.

Outside of demonstrating the clinical utility of ultrasound, it is also important to mention the safety and economic benefits related to using ultrasound as the primary imaging modality in minimally invasive procedures. Using ultrasound as an alternative to ionizing radiation minimizes radiation exposure and provides safe, real-time imaging capabilities. For many procedures, ultrasound is more economical than CT guidance. CT-guided procedures are nearly 2 times more expensive, and CT equipment is at least 4 times more costly than that for ultrasound [15]. Ultrasound use is already widely used for soft tissue biopsies, with reports showing increased accuracy, and decreased false-negative rates compared to CT guidance [15]. Besides for skin biopsies, ultrasound has become increasingly valuable in the diagnosis and treatment of melanoma, specifically through its use in locoregional staging, fine needle cytology, placement of presurgical guidewires, lymphocele and seroma aspiration, and electrochemotherapy [16]. At our institution, sonographic guidance has recently been used as a faster, more cost-effective alternative

for the biopsy of the peripheral lung lesions that abut the pleura.

Conclusion

To conclude, visceral pseudoaneurysms are an uncommon, but potentially deadly sequela of various conditions. In cases where the supplying artery is unable to be accessed through transarterial means, percutaneous embolization under sonographic guidance has proven to be an effective alternative that also aids in minimizing procedure cost and ionizing radiation exposure.

Patient consent

Written informed consent was obtained from the patient for publication of this case.

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