


# Iatrogenic Arteriovenous Fistula Following Routine Venipuncture in an Adult Without Coagulopathy: An Uncommon Consequence of a Common Procedure

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## ABSTRACT

**BACKGROUND:** According to Tonnessen BH (2011),<sup>1</sup> iatrogenic arteriovenous (AV) fistulas in adults most commonly occur due to endovascular access and procedures. Rarely, AV fistulas have been reported in low birth weight neonates following repeating venipuncture. This complication is extremely uncommon in adults, but has been reported after routine venipuncture for blood transfusion.

**CASE PRESENTATION:** We report the case of an elderly female patient who presented to the office for evaluation of left upper extremity swelling, ecchymosis, and dilated vessels after routine venipuncture at an outpatient laboratory. She was subsequently found to have an acquired AV fistula from her left cephalic vein to a small branch artery.

**CONCLUSION:** This case demonstrates the rare but relevant risk in routine venipuncture and may underscore the benefit of using ultrasound guidance in high-risk populations, such as patients with coagulopathies, or thin, fragile veins, like the elderly or neonates.

**KEYWORDS:** Venipuncture, phlebotomy, arteriovenous fistulas, iatrogenic

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## Case Report

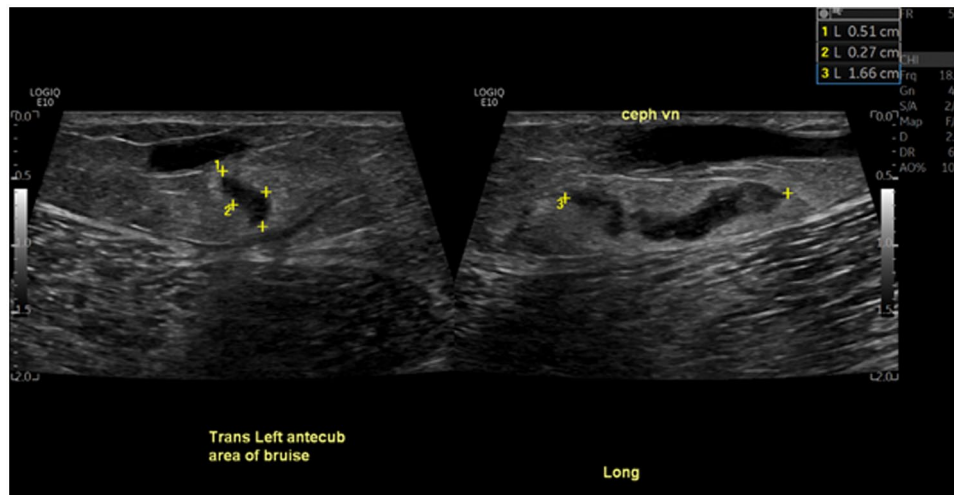
An elderly female with a history of type II diabetes mellitus, hypertension and stage IV chronic kidney disease initially presented to the office to follow-up with her diabetes. Three days prior, she underwent routine venipuncture in the outpatient laboratory for a hemoglobin A1C. During her venipuncture by a trained phlebotomist, she recalled experiencing immediate pain upon the needle entering her arm on the first attempt. She stated this pain radiated throughout her arm. Despite this pain, her blood was drawn successfully and bandaged. She was seen the same day by a nurse practitioner in the office for diabetes management without any further complaints noted about her arm. The following day, she notified the office that she had considerable pain and swelling in her left antecubital fossa. She was advised to ice and elevate her arm, which she did for 2 days without improvement. Upon telephone follow up with a nurse, she continued to complain of pain, swelling and bruising, and she was advised to make an appointment to see a provider. During a clinic visit the same day, a full history was obtained, and an exam was performed. On examination, the patient was noted to have a 5 cm × 2 cm area of ecchymosis along the left antecubital fossa with an underlying dilated venous structure without bruit or palpable thrill. She had no evidence of neurovascular compromise with intact and equal radial pulses and intact sensation. Given concerns for possible underlying

pseudoaneurysm, aneurysm, hematoma or fistula, a venous ultrasound performed in the radiology department, identified a 1.7 × 0.3 × 0.5 cm hematoma in the antecubital fossa posterior to the cephalic vein (Figure 1), as well as pulsatile flow and an arterialized waveform in the left cephalic vein (Figure 2). An abnormal connection between a small arterial branch and the cephalic vein was visualized, consistent with an arteriovenous fistula (Figures 3 and 4). Subsequently, the patient was referred to vascular surgery, who determined that this small arteriovenous fistula was likely to heal without any further intervention. The patient was seen in follow-up 1 week later in our office and noted resolution of edema, bruising and hematoma; however, dilated venous structures were still palpable on antecubital exam with intact pulses and the absence of both bruit and thrill. Unfortunately, the patient has subsequently been lost to follow up in the intervening time.

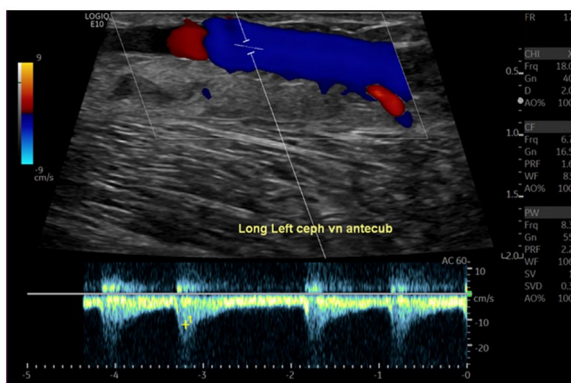
## Discussion

An arteriovenous (AV) fistula is an abnormal connection between an artery and a vein that creates a shunt and can occur congenitally, iatrogenically, or from a non-iatrogenic trauma.<sup>2</sup> AV fistula caused by routine venipuncture is extremely rare in adults and is more frequently documented in neonates after repeated venous punctures.<sup>3</sup> Signs and symptoms of AV fistula on clinical examination may include bruit, thrill, and dilated

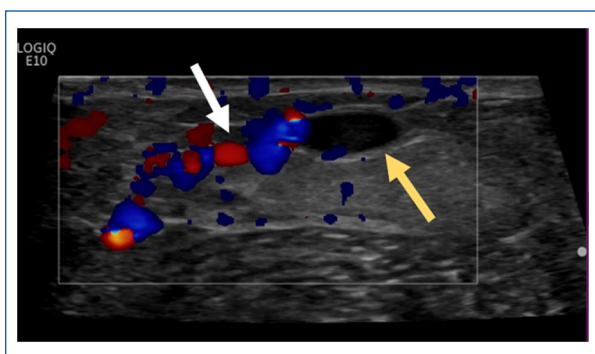




**Figure 1.** Grayscale ultrasound (US) at the left antecubital fossa in transverse and longitudinal views reveals a  $1.6 \times 0.5 \times 0.3$  cm serpentine, avascular, hypoechoic collection (yellow calipers) deep to the cephalic vein, which represents a small hematoma.



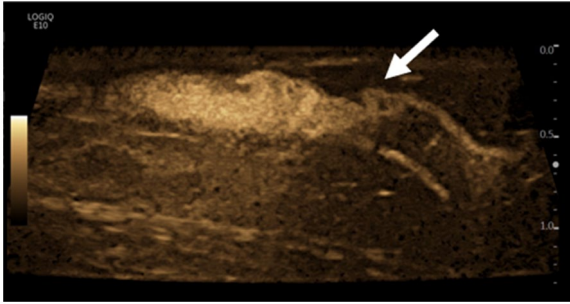
**Figure 2.** Longitudinal Color and spectral Doppler US at the left antecubital fossa reveals a pulsatile, arterialized waveform in the cephalic vein, concerning for an arteriovenous fistula.



**Figure 3.** Transverse Color Doppler US the left antecubital fossa reveals a small tortuous arterial branch (white arrow) joining the cephalic vein (yellow arrow) confirming arteriovenous fistula as cause for the pulsatile waveform in Figure 2.

veins, whereas pseudoaneurysm will have bruit, but absence of dilated veins and thrill.<sup>4</sup> Norcross and Shackford reported a similar case in 1988 of a 27-year-old female who presented with a

bruit and thrill noted on a routine examination, following venipuncture 2 years earlier.<sup>5</sup> This patient ultimately required surgical intervention. Omura et al highlighted several similar cases of AV fistulas occurring during blood donation, including their own.<sup>4</sup> In their own case, they mention multiple venipuncture attempts, while 2 of the other cases reported suggest possible arterial punctures. In this case report, the patient did not report repeated attempts, nor did she report noticing any “bright red blood” or “pulsatile flow” when asked about possible contributing factors. Additionally, Serra et al conducted a systematic review of venipuncture complications, which reviewed 29 articles identified through a Medline and SCOPUS search.<sup>6</sup> They concluded the most common complications, apart from pain and fear, were hematoma, thrombosis, arterial puncture, infection, nerve damage and vasovagal response. They identified AV fistula and compartment syndrome among the rare reactions. In their review, the authors noted that successful venipuncture depends on identifying an appropriate site and vein selection as well as using proper techniques. Another factor that may contribute to difficulty with venipuncture and thus complications fragile veins, particularly in elderly or pediatric populations. Multiple attempts at venipuncture, either due to inadequate technique or difficult access, have been associated with an increased risk of complications. In our case, the patient was elderly, but did not report multiple attempts. Factors identified for successful venipuncture included site selection and technique.<sup>6</sup> Upton et al., cited<sup>7-12</sup> Feusner JH (1988), Sussman LN (1974), Ries CA (1979), Tamir A (1984), Gilbert MS (1986), and Hyshaw C (1979), who state that patients with coagulation deficiencies, such as hemophilia, are some of the most vulnerable in terms of the development of AV fistulas from penetrating traumas, including routine venipuncture. This is due to hematomas in the setting of coagulation deficiencies being less likely to resist the arterial pressure as a shunt develops.<sup>13</sup> This patient had no evidence of coagulopathy in her history or



**Figure 4.** Longitudinal microvascular flow US at the left antecubital fossa confirms the abnormal connection between a small arterial branch and the cephalic vein (white arrow). This technique improves visualization of blood flow in small structures such as superficial arterial and venous branches.

laboratory studies, including a previously normal PT/INR and platelet count. She was not prescribed medications that would contribute to the development of a coagulopathy. Color and spectral Doppler ultrasound has been shown to be a noninvasive, sensitive (95%–97%), and cost-effective means of diagnosing AV fistulas and other vascular injuries secondary to venipuncture.<sup>14</sup> The mosaic bidirectional flow on color Doppler ultrasound is characteristic of an AV fistula (Figure 3).<sup>14</sup> Spectral Doppler can demonstrate the arterialized or high velocity flow in the draining vein, and low-resistance waveform in the supplying arterial branch (Figure 2).<sup>14</sup> Another vascular ultrasound technique, B-flow imaging, can detect blood flow on grayscale images without the artifact from high or low flow velocities typically seen with color Doppler. This technique can improve detailed evaluation of vascular structures that may be obscured by artifact with Doppler images (Figure 4). Unlike Doppler, this technique cannot provide information on flow direction or velocity.<sup>15</sup> As in this case, conservative observational treatment approach is preferred with small AV fistulas, as the AV fistula may spontaneously thrombose, not requiring repair.<sup>16,17</sup> However, large symptomatic AV fistulas should be repaired surgically.<sup>13</sup> Risks associated with large shunts include high output heart failure, consumptive coagulopathies, bacterial endocarditis, carpal tunnel syndrome, and distal ischemia.<sup>13</sup>

### Conclusion

This case demonstrates the rare, but relevant risk in routine adult venipuncture and may underscore the benefit of using ultrasound guidance in high-risk populations, such as those with intrinsic coagulopathies, difficult access, or thin, fragile veins, such as the elderly or pediatric populations.

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None.

### Author Contributions

Therese F Anderson: Responsible for initial patient encounter, initial manuscript draft and review of literature. Robyn Lee

Reese: Responsible for manuscript edits, secondary review of literature and initial image selection. Matthew McCann: Responsible for initial ultrasound reading with Manisha Salinas, image formatting as well as manuscript edits. Lauren F Alexander: Responsible for initial ultrasound reading with Matthew McCann, image formatting as well as manuscript edits. Manisha Salinas: Responsible for manuscript edits, secondary review of literature and formatting.

### Availability of Supporting Data

Not applicable.

### Ethical Approval

Not applicable.

### Consent

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy. It is available upon request.

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