

## Arteriovenous fistula following needle puncture for blood donation

*Michelle C. Omura, Marcia D. Haimowitz, and Samuel S. Ahn*

**S**erious complications due to blood donation, such as those resulting from accidental arterial puncture during blood draw, are uncommon.<sup>1</sup> Although arteriovenous (AV) fistula formation following various arterial injuries is well documented in the English literature, AV fistula following needle puncture for blood donation is rare.<sup>1-3</sup> We describe such a case and discuss strategies for donors and health-care providers to help manage and possibly prevent adverse events from occurring after inadvertent arterial puncture during blood donation.

### CASE REPORT

A 23-year-old right-handed man presented to donate whole blood in July 2001. The first attempt to draw blood from the right antecubital fossa was unsuccessful. The donor informed the collections staff that he had exercised earlier without drinking, so he was advised to drink some water, and a second attempt was made by a different staff member from the left arm. The procedure was discontinued when the phlebotomist noted fast, bright red blood flow. Suspecting an arterial puncture, the needle was removed, pressure was applied at the puncture site for 10 minutes, and ice was applied for 15 minutes.

Shortly afterward, the donor reportedly developed 3 × 2-in. ecchymoses over both the right and the left antecubital fossas and experienced intermittent localized

pain in the venipuncture areas. The donor stated that this was the fifth time he presented to donate, but it was the only time he experienced any difficulty with venipuncture.

Following this incident the donor refrained from lifting weights with his upper extremities, but continued to play soccer. The bruising and pain subsided within 2 weeks. No mass was noted. "A couple weeks" after donation, the donor noticed a thrill in the left antecubital fossa, but did not inform the collections staff or seek treatment until January 2002. He was referred to a vascular surgeon in April 2002.

A review of the patient's medical record disclosed no history of major illness or trauma. Physical examination revealed an apparent AV fistula with a loud bruit and palpable thrill in the left antecubital area. Heart rate decreased slightly upon occlusion of the fistula. The median antecubital, cephalic, and basilic veins were readily visible and slightly more prominent on the left arm than the right. Radial pulses were slightly diminished in the left arm when compared to the right. Sitting blood pressure and pulse were normal. Neurologic examination was normal. There was no enlarged pulsatile mass in the left arm to suggest a pseudoaneurysm and no evidence of a residual hematoma.

The patient underwent outpatient surgery 1 week later for repair of a left brachial artery to median antecubital vein AV fistula (Fig. 1). The fistula was disconnected and the vessels were repaired by primary figure-of-eight anastomosis of the brachial artery and lateral venorrhaphy of the median antecubital vein. At the end of the procedure there were no thrills or bruits; Doppler signals were normal throughout the arterial and venous systems. The patient tolerated the procedure well and was sent home the same day. At his 3-week follow-up appointment, the patient reported that he had returned to normal activity within 1 to 2 weeks of the procedure. Upon exam, there was no evidence of hematoma or seroma (Fig. 2b), no bruits or thrills, and no signs of neurologic deficit. His brachial and radial pulses were full bilaterally. Follow-up at 24 months showed no recurrence of the fistula and no adverse sequelae.

---

**ABBREVIATION:** AV = arteriovenous.

From the Department of Surgery-Vascular, UCLA Center for the Health Sciences; and the American Red Cross Blood Services, Southern California Region, Los Angeles, California.

*Address reprint requests to:* Michelle C. Omura, BS,

Department of Surgery-Vascular, UCLA Center for the Health Sciences, Los Angeles, CA 90095; e-mail: sahn@mednet.ucla.edu

Received for publication January 30, 2004; revision received August 1, 2004, and accepted August 4, 2004.

TRANSFUSION 2005;45:270-273.

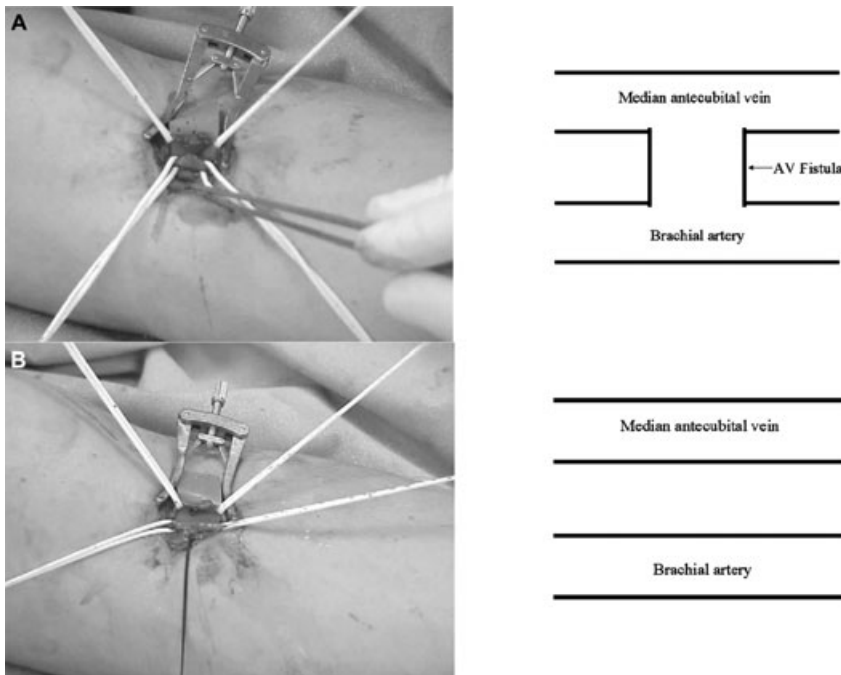
**PUBLISHED REPORTS**

An Internet search of PubMed, a service of the National Library of Medicine (<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=PubMed>), was performed. A PubMed search for the phrase “arteriovenous fistula” produced more than 9000 items. Articles went back until 1950. Titles were scanned for relevancy to blood donation. Abstracts (if provided) and/or the MeSH terms were further reviewed from select titles to ascertain relevancy. Titles that did not deal with a relevant site, condition, or

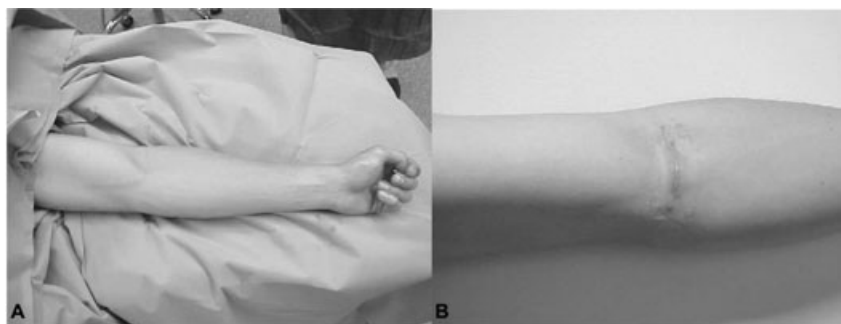
clinical situation were not further reviewed, nor were articles that were not written in English or those involving nonhuman [animal] subjects.

Common MeSH terms were determined among titles that appeared relevant, and a final PubMed search was performed for “arteriovenous fistula” “brachial artery” (both with quotation marks) using limits for “human” and “English.” This produced 135 items that were again reviewed. This search produced one article related to blood donation<sup>2</sup> and one related to phlebotomy.<sup>5</sup>

Additional PubMed searches for blood donor complications and injuries related to arterial puncture were performed. Relevant articles found through PubMed searches for “blood donor injury” and “blood donor complication” (not in quotation marks) were retrieved if potentially related to arterial puncture and/or AV fistula formation. The references in these articles were also reviewed. Through these searches, a second case of AV fistula was found documented in an abstract<sup>3</sup> cited in an article.<sup>4</sup> A third AV fistula was described, based on personal communication, in a review article.<sup>1</sup> A possible fourth case was also documented: the article<sup>6</sup> lists a reported AV fistula in its tally of complications; however, it is unclear whether this is a separate occurrence or whether it is the same case reported in the review article mentioned above.<sup>4</sup>



**Fig. 1. (A) Left brachial artery to median antecubital vein AV fistula, before disconnection. This shows a sideways H configuration of the artery (below) and vein (above) with the connecting AV fistula. (B) Repaired left brachial artery and median antecubital vein following disconnection of AV fistula. The artery and vein have been separated (vein above, artery below).**



**Fig. 2. (A) Patient's left arm, before surgery. Note the dilated veins in the arm. (B) Patient's left arm, 3 weeks after surgery. Note the absence of dilated veins.**

**COMMENT**

The incidence of arterial puncture during whole blood donation is very low, and has been reported as ranging from 0.0029 percent (1/34,000) to 0.009 percent (1/11,000).<sup>4</sup> The incidence was reported as five times higher in newly trained phlebotomists (<1 years) than experienced staff (>5 years) ( $p = 0.002$ ).<sup>4</sup> More recent unpublished data from the American Red Cross Blood Services based on its national donor complication monitoring program shows a higher arterial puncture incidence of 0.011 percent during 2003 with 807 arterial punctures reported among 7,538,661 venipunctures (whole blood and apheresis) (L. Chambers, American Red Cross Biomedical Headquarters, Washington, DC, personal communication).

The most common complication from an inadvertent arterial puncture occurring during blood donation is a hematoma, which occurs in 33 percent of all arterial punctures.<sup>4</sup> In comparison, the reported rate of hematoma formation in the general whole-blood donor population ranges from 0.35 to 0.66 percent.<sup>4,7</sup> Thus, a hematoma is 50 to 100 times more common after an arterial puncture in comparison to a venous puncture. This phenomenon may be explained by the fact that an artery is under high systemic pressure whereas a vein has low intraluminal pressure.

In non-blood donation settings, iatrogenic inadvertent vascular injuries resulting in AV fistulas do occur following vascular cannulation and catheterization procedures, as well as after repeated venous and/or arterial punctures in children, especially those with intrinsic coagulation deficiencies,<sup>8</sup> and in neonates.<sup>9</sup> A very uncommon case of AV fistula following venipuncture for routine blood sampling in an adult woman has also been reported.<sup>5</sup> Specifically regarding blood donation, reports of AV fistula following inadvertent arterial puncture are also very rare. A literature review revealed three documented cases. Lung and Wilson<sup>2</sup> reported a case in 1971 in which a 25-year-old man was found to have a bruit over the left antecubital fossa several months after a blood donation. At the time of donation the phlebotomist noted rapid blood flow, suggestive of arterial puncture. The fistula was surgically repaired without difficulty. Wissel and colleagues<sup>3</sup> reported a similar case 29 years later in a 26-year-old man undergoing routine blood donation. The drawn blood appeared brighter red in color; however, pulsation was absent. The bag filled in 4 minutes. Two weeks later the donor noted a palpable thrill in his left antecubital fossa, and the AV fistula was later confirmed and surgically repaired without complication.

A third case was found in a review article by Newman<sup>1</sup> describing blood donor reactions and injuries. A male donor complained of bruising, stiffness, and soreness of the left arm and wrist swelling 3 days after donation. He was referred to a cardiovascular surgeon who diagnosed an AV fistula, along with a pseudoaneurysm, 3 weeks after donation that was surgically repaired without further complications. Popovsky and coworkers<sup>6</sup> mention a possible fourth case of AV fistula formation, although little information is provided; this may be the same case that Newman described above, especially because it may have involved a pseudoaneurysm, was reported during a similar time frame, and was reported to the same organization.

We report a case of AV fistula following blood donation in a repeat donor who had previously given blood without incident. In this case the donor was perhaps dehydrated from exercise and warm weather, making his veins unusually difficult to detect. After the first phlebotomist failed to find a vein in the right arm, a second phlebotomist attempted to draw from the left arm. We suspect

that during this second attempt the needle went through the left antecubital vein and punctured the brachial artery, creating a fistula between the two vessels.

It is interesting to note that the donor remained active following the arterial puncture and within 1 to 2 weeks of the incident he had returned to playing soccer and exercising regularly. One could speculate that increased cardiac output attributed to exercise might have impeded coagulation at the puncture site and therefore aided in the fistula formation. Physical exercise, however, has been shown to actually induce hypercoagulation and increase platelet number and activity. This is accompanied by transient fibrinolysis, which counteracts the increased coagulability, suggesting that in healthy people there is a delicate balance between blood clot formation and dissolution following exercise.<sup>10-12</sup> Thus, it is unclear whether exercise could have played a role in development of the donor's AV fistula following the arterial puncture.

Another vascular complication following blood donation with inadvertent arterial punctures, as previously mentioned, is pseudoaneurysm. Development of pseudoaneurysm, like AV fistula, is rare in blood donors and also often requires surgical intervention. Three cases were published between 1994 and 1995<sup>1</sup> and another was reported in 2001.<sup>4</sup> Based on data reported to the National American Red Cross during 1999 and part of 2000, Newman estimated that 1.5 percent (4/265) of arterial punctures led to development of a pseudoaneurysm.<sup>4</sup> The American Red Cross Blood Services' national donor complication monitoring program had no AV fistulas and one pseudoaneurysm reported in 2003, which is an incidence of 0.12 percent (1 pseudoaneurysm of 807 arterial punctures) (L. Chambers, American Red Cross Biomedical Headquarters, Washington, DC, personal communication).

Norcross and Shackford<sup>5</sup> write that AV fistulas secondary to venipuncture for blood specimens are "highly preventable events" and that venipuncture should only be performed by "trained and experienced health professionals." Adherence to established guidance for blood sample collection should prevent puncture of the brachial artery. In addition, they advise taking time to search for the best vein and avoid deep probing or "running through" the vein with the needle. Newman<sup>4</sup> feels that because arterial punctures during blood donation are so rare probably little can be done to reduce the incidence, except to have experienced staff and "perhaps a calm working environment." Even if measures are taken to avoid an arterial puncture, if it does occur during blood donation, immediate recognition is crucial so that pressure can be applied for an extended period of time to attempt to prevent serious complications from arising. Little information could be found in the literature regarding specific management and care in the case of inadvertent arterial puncture during blood donation, which is not surprising since it is a rare event. Scientific data on how to prevent AV fistula

following donation are lacking, such as how long to apply direct manual pressure to the phlebotomy site, how long a pressure dressing should be kept in place, what type of activity should or should not be performed by the donor and within what time frame, etc. The AABB's *Technical Manual* advises that if an arterial puncture is suspected, the needle should be withdrawn immediately and firm pressure applied for 10 minutes.<sup>13</sup> A pressure dressing should be applied and the presence of a radial pulse should be checked. If the pulse is not palpable or is weak, a blood bank physician should be called.<sup>13</sup> Newman<sup>4</sup> describes a similar policy, recommending that the pressure bandage be kept in place for 5 hours and that donors be advised not to use the arm in "any strenuous manner" for a few days.

Blood donors who experience an arterial puncture, and blood collection staff who perform follow-up of donation-related injuries, should be advised what to look for to recognize the possibility of an AV fistula or a pseudoaneurysm. The phlebotomy site should return to its prephlebotomy state after an arterial puncture; however, there may be a hematoma that will almost always resolve with time. Donors should be instructed to see a qualified medical professional as soon as possible if dilated veins, a thrill (which can be described as "a vibration"), and/or a pulsatile mass are noted to rule out an AV fistula and/or a pseudoaneurysm.

Usually, the history and physical examination alone gives the correct diagnosis of an AV fistula or a pseudoaneurysm.<sup>14</sup> An AV fistula will have a thrill, bruit, and dilated veins. A pseudoaneurysm may have a bruit, but not a thrill or dilated veins; instead, it presents as a pulsatile mass with or without a bruit. Occasionally, however, it can occur in combination with an associated AV fistula in which case there will be a thrill, as well as a bruit and dilated veins. If an AV fistula is addressed early, it is treated easily with outpatient surgery and should resolve without serious sequelae.

## REFERENCES

1. Newman BH. Donor reactions and injuries from whole blood donation. *Transfus Med Rev* 1997;11:64-75.
2. Lung JA, Wilson SD. Development of arteriovenous fistula following blood donation. *Transfusion* 1971;11:145-6.
3. Wissel ME, Kish K, Schumacher M, Smead WL. Arteriovenous fistula after whole blood donation [abstract]. *Transfusion* 2000;40(Suppl):77S.
4. Newman BH. Arterial puncture phlebotomy in whole-blood donors. *Transfusion* 2001;41:1390-2.
5. Norcross WA, Shackford SR. Arteriovenous fistula: a potential complication of venipuncture. *Arch Intern Med* 1988;148:1815-6.
6. Popovsky MA, Whitaker B, Arnold NL. Severe outcomes of allogeneic and autologous blood donation: frequency and characterization. *Transfusion* 1995;35:734-7.
7. Ranasinghe E, Harrison JF. Bruising following blood donation, its management and the response and subsequent return rates of affected donors. *Transfusion Med*, 2000 June;10 (2):113-6.
8. Upton J, Sampson C, Havlik R, Gorlin JB, Wayne A. Acquired arteriovenous fistulas in children. *J Hand Surg [Am]*, 1994 July;19A:656-8.
9. Ontell SJ, Gauderer MW. Iatrogenic arteriovenous fistula after multiple arterial punctures. *Pediatrics*, 1985 July;76 (1):97-8.
10. El-Sayed MS. Effects of exercise on blood coagulation, fibrinolysis and platelet aggregation. *Sports Med*, 1996 November;22 (5):282-98.
11. Bourey RE, Santoro SA. Interactions of exercise, coagulation, platelets, and fibrinolysis – a brief review. *Med Sci Sports Exerc*, 1988 October;20 (5):439-46.
12. Prisco D, Francalanci I, Filippini M, Hagi MI. Physical exercise and hemostasis. *Int J Clin Laboratory Res*, 1994;24 (3):125-31.
13. Brecher ME, ed. *Technical Manual*, 14th edn Bethesda, MD. American Association of Blood Banks 2002:100.
14. Peter Gloviczki Audra A, Noel and Larry H. Hollier, "Arteriovenous Fistulas and Vascular Malformations." In: Haimovici's *Vascular Surgery*, 5th edn (eds Enrico Ascher, others) Malden. MA. Blackwell Publishing, 2004, p 994. ◼