Post-Traumatic Arteriovenous Fistulas Leading to Heart Failure

Artem Rabtsun a, Anne Lejay b,*, Shoraan Saaya a, Savr Bugurov a, Nabil Chakfé b, Andrey Karpenko a

a Department of Vascular and Hybrid Surgery, Meshalkin National Medical Research Center, Ministry of Public Health of the Russian Federation, Novosibirsk, Russia
b Department of Vascular Surgery and Kidney Transplantation, Les Hôpitaux Universitaires de Strasbourg, University of Strasbourg, Strasbourg, France

**Introduction:** The detection of acquired arteriovenous fistulas (AVFs) is mostly incidental. However, the modification of haemodynamic conditions secondary to AVFs can lead to dramatic systemic complications, including cardiac complications. In this report, two unusual cases of congestive heart failure secondary to acquired AVF are presented.

**Report:** A 40 year old man with past history of gunshot wound of the right flank complained of severe right limb swelling and shortness of breath. An AVF between the right external iliac artery and external iliac vein responsible for the cardiac failure was diagnosed. A 40 year old woman with past history of spinal surgery complained of breathlessness and lower limb oedema. She presented with recurrent episodes of ascites and dyspnoea. An AVF between the right common iliac artery and the common iliac vein responsible for high output cardiac failure was diagnosed. Open surgery was performed in both patients and treatment of the AVFs led to the resolution of all symptoms. Follow up at four and three years, respectively, was uneventful in both cases.

**Discussion:** Although rare, heart failure secondary to an AVF can be encountered. These rare cases highlight the significance of careful inquiry into the patient’s medical history and meticulous follow up physical examinations for patients with injuries in close proximity to vessels.

© 2021 The Author(s). Published by Elsevier Ltd on behalf of European Society for Vascular Surgery. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

**Keywords:** Arteriovenous fistula, Heart failure

**INTRODUCTION**

Arteriovenous fistula (AVF) is defined as the development of an abnormal connection between the arterial and venous systems. AVFs can be divided into two groups: congenital and acquired. Acquired AVF can be further subdivided into surgically created (e.g., for haemodialysis) or secondary to vascular injury, whether traumatic (mostly by penetrating gunshot injury) or procedure related (iatrogenic). A traumatic or iatrogenic AVF can occur anywhere there is resulting injury.

Multiple reports of acquired AVFs are described in the literature, but the diagnosis of AVF is usually delayed, and the detection of the AVF is most often incidental. However, the modification of haemodynamic conditions secondary to the AVF can lead to dramatic systemic complications, including cardiac complications. In this report, two cases of congestive heart failure secondary to acquired AVF are presented.

**REPORTS**

**Case 1**

A 40 year old man with a past history of a gunshot wound on the right flank 25 years earlier presented with progressive shortness of breath, with acute worsening in the past six months, and severe right limb swelling. Cardiac examination revealed a mild tachycardia with a systolic cardiac murmur. Physical examination revealed severe right limb oedema with dilatation of the superficial veins, and a painless pulsatile mass in the right iliac fossa, with a strong thrill spreading from the inguinal region to the lower abdominal quadrant.

Echocardiography revealed enlargement of the four cardiac chambers with moderate mitral and tricuspid regurgitation. A pulmonary artery pressure of 48 mmHg with dilatation of the branches of the pulmonary artery was found. The inferior vena cava (IVC) was dilated to 4.2 cm and collapsed by 18% during inspiration.

Computed tomography angiography (CTA) revealed an AVF between the right external iliac artery (EIA) and the right external iliac vein (EIV), with increased vessel diameters (EIV 7.5 cm, IVC 4.6 cm, common iliac artery [CIA] 2.5 cm, EIA 6 cm) (Fig. 1).

Open surgery was selected, considering the pronounced angulation of the iliac arterial axis and the aneurysmal degeneration of the iliac arteries. The right common
femoral artery (CFA), superficial and deep femoral arteries were isolated through a groin incision. Retroperitoneal exposure of the distal aorta and iliac arteries was performed through an oblique right lower quadrant incision. A 10 mm polyethylene terephthalate prosthesis was anastomosed to the CIA and to the CFA in an end to end fashion. The internal iliac artery was ligated. The hole responsible for the AVF in the right EIV was stitched with a mattress suture. Operating time was 250 minutes and aortic clamp time 15 minutes. Blood loss was 500 mL. The post-operative course was uneventful.

Echocardiography on post-operative day four showed an IVC diameter of 2.4 cm, which collapsed by 47% during inspiration. A significant drop in estimated pulmonary artery pressure (PAP; from 48 mmHg to 36 mmHg) and a nearly total absence of valvular regurgitations were noted. Post-operative duplex ultrasonography (DUS) confirmed the patency of the bypass, with no remaining AVF. The four year follow up was uneventful, with the patient showing a complete lack of symptoms. There was no lower limb swelling. DUS confirmed the patency of the bypass, with no remaining AVF. Echocardiography showed the absence of valvular regurgitations; estimated PAP was 35 mmHg.

**Case 2**

A 40 year old woman was admitted with breathlessness and oedema of the lower limbs. Her past history included a lumbar decompression six years previously. The post-operative course was complicated by lower limb oedema and recurrent episodes of ascites, which required paracentesis (four times in three years, with a maximum drained volume of 25 L). An ovarian resection for suspicion of neoplasia was performed, but pathological examination revealed no atypical cells.

Physical examination revealed tachycardia, a 3/6 grade midsystolic murmur throughout the precordium, jugular venous distention, non-tense ascites and bilateral pitting oedema up to the thighs.

Echocardiography revealed enlargement of the four cardiac chambers, as well as significant mitral and tricuspid regurgitation, decreased left ventricular ejection fraction and pulmonary hypertension with a systolic PAP of 55 mmHg. The IVC was dilated to 4.2 cm. The hepatic veins were dilated, and hepatomegaly and ascites were noted.

CTA revealed an AVF between the right CIA and the right common iliac vein (CIV), with increased veins diameters (right CIV 5 cm, left CIV 6 cm, IVC 10 cm). The size of the AVF was around 20 mm (Fig. 2).

Open surgical treatment was proposed considering the size and location (near the iliac artery bifurcation) of the AVF. A transperitoneal aorto-iliac approach was performed allowing the control of the infrarenal aorta, the IVC, and the common iliac arteries and veins. Five litres of ascites were evacuated. The 20 mm defect responsible for the AVF was delineated and repaired with a U shaped suture. The total operating time was 180 minutes. Blood loss was 100 mL. The post-operative course was uneventful. The clinical symptoms subsided rapidly in the post-operative period.

![Figure 2](image_url). Computed tomography angiography revealed an arteriovenous fistula from the right common iliac artery to the right common iliac vein, with increased vein diameters (right common iliac vein 5 cm, left common iliac vein 6 cm, inferior vena cava 10 cm).
Echocardiography on post-operative day four showed a significant drop in estimated PAP (from 55 mmHg to 40 mmHg). No valvular regurgitation was noted. Post-operative DUS confirmed the patency of the iliac arteries and veins, with no remaining AVF.

The three year follow up was uneventful, with the patient showing a complete lack of symptoms, except for minor swelling of the limbs after a long day of standing. DUS confirmed patency of the iliac vessels, with no remaining AVF. There were no valvular regurgitations on echocardiography and the estimated PAP was 38 mmHg.

**DISCUSSION**

In the present report, two cases of acquired AVF responsible for heart failure are reported. The first case was traumatic, diagnosed 25 years after the initial gunshot injury. The second was iatrogenic, diagnosed six years after spinal surgery. In both cases the diagnosis was delayed probably because clinical manifestations arose a long time after the initial vascular injury and were not typical for AVF. However, both cases highlight the importance of recognising AVF as a cause of unexpected heart failure.

Invasive procedures (arterial or venous punctures), surgical procedures or trauma may result in an acquired AVF. When heart failure of uncertain aetiology appears in patients previously submitted to one of the abovementioned procedures, careful clinical examination should assess for a pulsatile mass, murmur, or thrill over the scars, and the development of varicose veins in the affected extremity. A Nicoladoni—Bransham sign (if pressure is applied to an artery proximal to an AVF, the bruit and thrill disappears, and the pulse and heart rates become normal) should be looked for.

Once the diagnosis of AFV is made, rapid resolution of cardiac dysfunction is usually obtained after surgical repair. Both cases reported here were treated by open surgery, but the application of endovascular therapies in patients presenting with iatrogenic AVF has become more common over the past decade. Surgical exposure for the treatment of traumatic abdominal or pelvic AVF can be challenging and treacherous, especially when the diagnosis is delayed. Elevated venous pressure and surrounding tissue inflammation can make the local conditions hostile to open surgical repair. Moreover, large collateral vessels with a complex venous anatomy are frequently involved, incurring risk of substantial blood loss and considerable morbidity and mortality. A wide variety of endovascular devices can be used for AVF treatment: coil embolisation; septal occluders; covered stents; endografts; or iliac branch devices. Nevertheless, embolisation can be risky owing to high flow and large vessel diameters near the AVF, leading to pulmonary, pelvic, or lower limb complications.

Data on the time course of heart failure after AVF and the possible risk factors are lacking but essential to guide clinical practice. It has been shown that heart failure secondary to AVF commonly occurs after extensive latency periods and that the risk of heart failure increases with an increasing AVF feeding artery diameter. Accordingly, early recognition of the AVF could restore physiological haemodynamic conditions and therefore prevent the risk of heart failure and enhance patient outcomes.

In conclusion, heart failure due to acquired AVF is a very rare condition, but the importance of an early AVF diagnosis is highlighted by the number that become evident after complications have developed months to years after the vascular injury.

**ACKNOWLEDGEMENTS**

We acknowledge Irina Popova, Alexandr Gostev, Alexey Cheban, and Pavel Ignatenko for their contribution to the manuscript.

**APPENDIX A. SUPPLEMENTARY DATA**

Supplementary data related to this article can be found at https://doi.org/10.1016/j.ejvsvf.2021.09.001.

**REFERENCES**

1. Jayroe H, Foley K. Arteriovenous fistula. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2021.
2. Asensio JA, Dabestani PJ, Miljkovic SS, Wenzl FA, Kessler 2nd JJ, Kalamchi LD, et al. Traumatic penetrating arteriovenous fistulas: a collective review. *Eur J Trauma Emerg Surg* 2021. https://doi.org/10.1007/s00068-020-01574-z [Epub ahead of print].
3. Salagean M, Ginghina C, Geana RC, Dragulescu R, Balcangiu Stroescu A, Stiru O, et al. Iatrogenic iliac arteriovenous fistula management after lumbar discectomy surgeries: a case report and review of the literature. *Heart Surg Forum* 2020;23:E863—6.
4. Ananthakrishnan G, DeNunzio M, Bungay P, Pollock G, Fishwick G, Bolia A. The occurrence of arteriovenous fistula during lower limb subintimal angioplasty: treatment and outcomes. *Eur J Vasc Endovasc Surg* 2006;32:67—59.
5. Ziporin SJ, Ifune CK, MacComara JP, Geraghty PJ, Choi ET. A case of external iliac arteriovenous fistula and high-output cardiac failure after endovenous laser treatment of great saphenous vein. *J Vasc Surg* 2010;51:715—9.
6. Canaud L, Hireche K, Joyceux F, D’Annoville T, Berthet JP, Marty-Ané C, et al. Endovascular repair of aorto-iliac artery injuries after lumbar spine surgery. *Eur J Vasc Endovasc Surg* 2011;42:167—71.
7. Brewster DC, Cambria RP, Moncure AC, Darling RC, LaMurglja GM, Geller SC. Aortocaval and iliac arteriovenous fistulas: recognition and treatment. *J Vasc Surg* 1991;13:253—64.
8. Petrov I, Tasheva I, Stankov Z, Polomski P, Georgieva G, Marinov K. Uneventful follow-up 2 years after endovascular treatment of a high-flow iatrogenic aorto-caval fistula causing pulmonary hypertension and right heart failure. *Methodist Debakey Cardiovasc J* 2019;15:152—4.
9. Kubelik D, Morelato J, Jetty P, Brandys T, Hajjar G, Hill A, et al. Endovascular repair of a chronic AVF presenting as postpartum high output heart failure. *EJVES Short Rep* 2016;31:19—22.
10. Wenzl FA, Miljovic SS, Dabestani PJ, Kessler 2nd JJ, Kotaru TR, Kalamchi LD, et al. A systematic review and individual patient data meta-analysis of heart failure as a rare complication of traumatic arteriovenous fistulas. *J Vasc Surg* 2021;73:1087—94.