Case Report

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Hybrid Management for Traumatic Iliac Arteriovenous Fistula

Adenauer Marinho de Oliveira Góes Junior, Matheus Oliveira Feijó and Fernanda Beatriz Araújo de Albuquerque

Department of Surgery, Universidade Federal do Pará, Belém, Pará, Brazil

Traumatic arteriovenous fistulas are usually the evolution of non-treated contiguous arterial and venous injuries inflicted by firearm projectiles. As time passes, these fistulas can lead to systemic and local repercussions. Endovascular management offers great benefit in reducing the risks of open surgery for correcting these fistulas, but unfortunately some endovascular resources are not always available.

In this situation, a hybrid management offering an endovascular strategy to control bleeding, while allowing an open disconnection of the affected artery and vein, may be useful in dealing with these complex injuries. In this article, the authors report a case of traumatic arteriovenous fistula between the common iliac vessels, managed with a hybrid strategy and make comments about practical issues regarding planning the open part of the procedure and anticipating possible complications when treating such injuries.

Keywords: *Iliac Artery; Iliac Vein; Arteriovenous Fistula; Surgery; Endovascular Procedures*

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INTRODUCTION

Traumatic arteriovenous fistulas (AVFs) are abnormal communications between arterial vessels and adjacent veins secondary to trauma; 90% are due to penetrating injuries, mostly caused by firearm projectile injuries [1–6].

Even though traumatic AVFs can resolve spontaneously, it only happens in 2% of cases [7], making AVFs one of the main chronic complications following vascular trauma [4,5,7,8].

AVFs can lead to local and systemic effects, mostly depending on their size and location, with a tendency towards enlarging the fistula's size and bringing additional complexity to delayed treatments. Traumatic iliac AVFs can be stablished if injuries to the involved vessels are not detected, for instance when retroperitoneal Zone 3 hematomas are not properly explored after penetrating trauma [7–9].

Corresponding author:

Adenauer Marinho de Oliveira Góes Junior, Domingos Marreiros 307, apt 802, Belém 66055-210, PA-Brazil.

Email: adenauerjunior@gmail.com

Systemic repercussions include diminishing vascular peripheral resistance, and increasing venous pressure and heart preload, increasing cardiac output, myocardial hypertrophy and possibly leading to congestive heart failure [4–8,10]; while local consequences can regard lower limb ischemia, varicose veins, edema and even leg ulcers [7–9,11].

The main pillar for traumatic AVF management is ceasing arteriovenous communication, by the open surgical approach or endovascular methods [4–8].

Open surgery may carry some disadvantages, especially when the traumatic AVF has been stablished for some time; fibrosis, anatomy distortion and venous hypertension can make it difficult to dissect anatomical structures, increasing the possibility of bleeding and adjacent structures' iatrogenic injuries, thus increasing morbidity and mortality [3,7,10,12].

Endovascular techniques include mainly the implantation of endoprostheses/stent grafts in cases in which vascular flow must be preserved or the occlusion of the involved vessels, when flow can be interrupted [4–7,9,13].

In cases of long stablished iliac vessel AVF open approach and vascular reconstruction can be especially challenging and risky, but sometimes limited endovascular resources can preclude an exclusive endovascular management. Depending on the available tools, a hybrid treatment involving conventional surgery and endovascular techniques may provide lower risks and good results [1,4,6,8,13].

Figure 1 Physical examination. (**a**) The arrows point towards dilated veins at the abdominal wall. (**b**) Lower limb edema.

Ethical Approval and Informed Consent

Ethical approval and informed consent were not required as all data were anonymized. The patient endorsed the description of his clinical course for educational purposes.

CASE REPORT

A 29-year-old male patient was sent to a vascular surgery consult. Two years earlier, the patient was submitted to a median laparotomy at another hospital after sustaining a gunshot wound to the left lower abdominal region; details about this previous procedure were unavailable.

Physical examination revealed left lower limb edema and diminished left femoral pulse; dilated veins were visible at the abdominal wall and thrill and murmur were detected at the left lower abdominal quadrant (Figure 1).

An abdominal computed tomography scan confirmed the presence of a traumatic AVF between the common left iliac vessels and revealed a large saccular dilation of the common left iliac vein and considerable distortion of the regional anatomy (Figure 2).

As endoprosthesis/stent grafts were not available, due to institutional limitations, an elective hybrid management was planned.

An open surgical approach was planned and performed through a transverse laparotomy. A preoperative bowel preparation was performed and on the surgical table, the patient was positioned with a lumbar cushion and a central line. An 8F sheath was placed at the right jugular vein (Figure 3) and an 8F sheath was also placed on the left common femoral artery.

During laparotomy, visceral adhesions were loosened, when necessary, in order to perform the exposure, through a Mattox maneuver, of the distal aorta and the left common iliac vessels. Before progressing the iliac vessel dissection, a guidewire was advanced to the distal aorta and an angioplasty balloon was placed over the AVF, under angiography guidance.

When the limit of safe dissection was thought to be reached, systemic anticoagulation was performed, followed by the balloon inflation, performing an "endoclamp" of the left common iliac artery (Figure 4).

The iliac vein was dissected as minimally as possible, just enough to place the arterial clamps. When proximal and distal arterial control was achieved, the guidewire and the balloon were removed, and the arterial clamps were applied.

After a longitudinal arteriotomy the communication with the venous system was identified and sutured through the arterial lumen, occluding the fistula.

Proximal and distal arterial stumps were resected, and arterial continuity was restored using a Dacron graft, interposed using end-to-end anastomosis; patency was angiographically documented using right femoral artery access before ending the procedure (Figure 5).

The patient received prophylactic antibiotics and anticoagulation during the hospital stay and was discharged without complications at post-operative day 7.

DISCUSSSION

The treatment of complex vascular injuries, especially those difficult to expose surgically, such as iliac AVFs, may benefit from endovascular procedures, mainly because they reduce bleeding and iatrogenic injuries that are risky and avoid large surgical incisions that are often necessary [10,11,14].

Unfortunately, endovascular treatments are not universally available. They require infrastructure, trained personnel and access to a range of endovascular devices.

When planning the endovascular treatment of a high-flow long established traumatic AVF, like the one described in this case, measuring arterial diameters carefully is of paramount importance. As time passes, low resistance flow through the fistula and the distal diminished arterial flow tends to make the proximal arterial diameter much larger than the distal diameter, sometimes making it difficult to find stent grafts/endoprostheses compatible with both proximal and distal arterial diameters [7,13,15,16].

In order to overcome the limitations imposed by these diameters' discrepancy, some endovascular solutions have been developed, such as flared stents, which allow the adaptation to different proximal and distal diameters, by assuming a conical configuration [7,8,13].

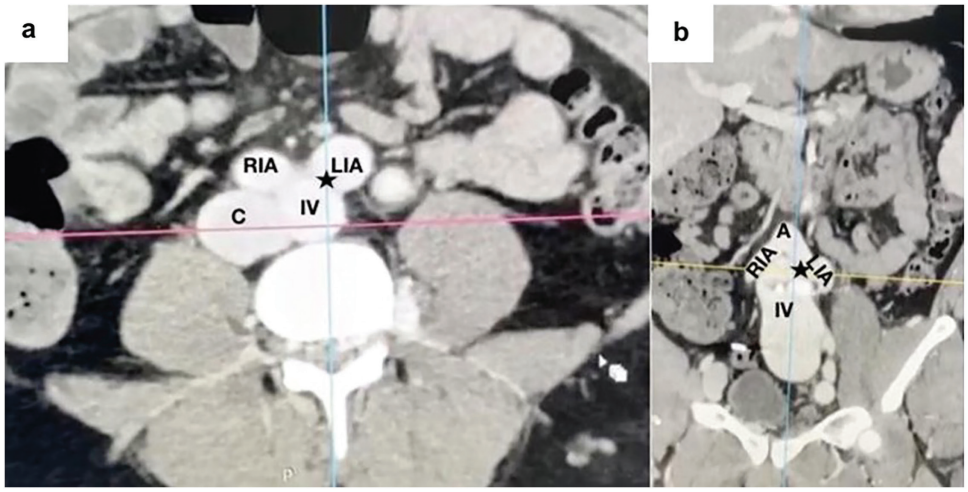

Figure 2 Abdominal computed tomography with intravenous contrast. (**a**) Axial view; RIA: right iliac artery; LIA: left iliac artery; IV: left iliac vein; ★: arteriovenous fistula (AVF) between the left common iliac vessels; C: inferior vena cava. (**b**) Coronal view. Note the large saccular dilation of the left common iliac vein.

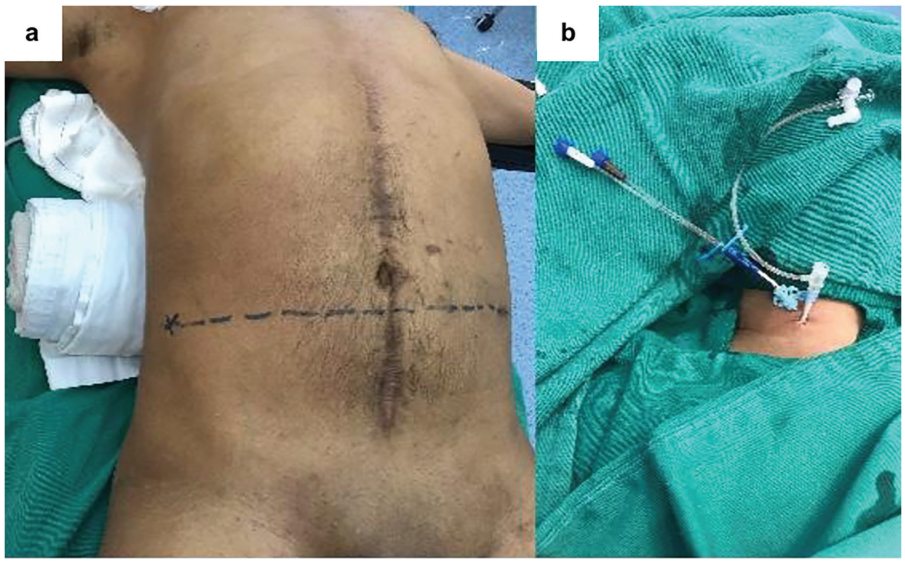

Figure 3 Preoperative preparation. (**a**) Planning for a transverse laparotomy. Note the presence of the lumbar cushion. (**b**) A central line and an 8F sheath placed at the right jugular vein.

If no stent grafts are available and vascular flow is required to be maintained, as in the case here described, artery and vein disconnection requires an open approach, in order to avoid further AVF complications [4,6,13].

During preoperative planning, considering complications in advance is important. There are two major risks involved: the first is accidental hollow visceral injury, because of adhesions provoked by previous surgical procedures, contaminating the abdominal cavity; the second is uncontrolled bleeding. Hybrid strategies can help diminish the risks of a purely open treatment.

A transverse laparotomy was chosen in order to avoid most of the adhesions associated with the previously performed midline incision, and the use of the lumbar cushion favors the exposure of deep pelvic structures. Bowel preparation provides a secondary advantage; by reducing intestinal content, it makes it easier to manipulate the bowel, losing adhesions and visceral rotation during the Mattox maneuver, favoring the exposure of the iliac AVF fistula.

Anticipating a possible hemorrhage, an 8F sheath was placed in the internal right jugular vein, the same access used for the central line. If necessary, the 8F sheath allows rapid blood product infusion, while the conventional central line catheter can be used for drug infusion and hemodynamic monitoring [7,13,16].

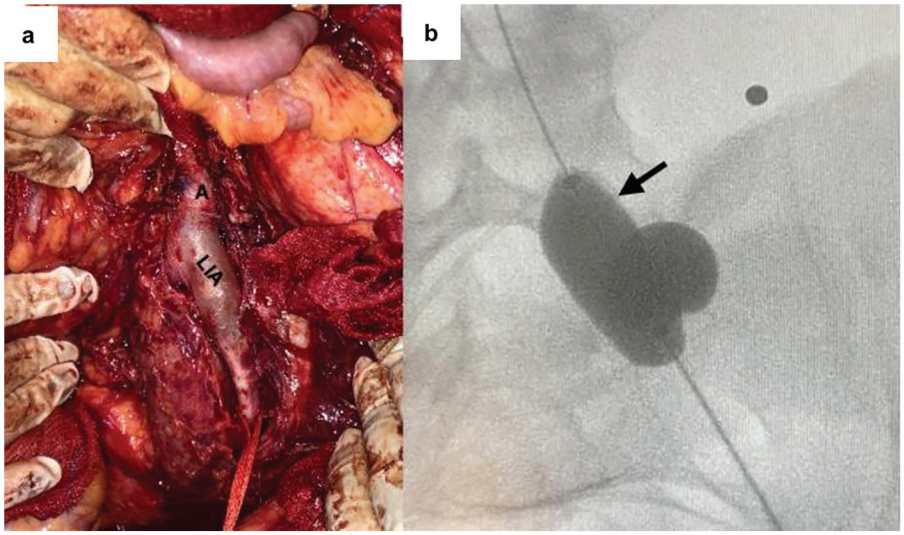

Figure 4 Intraoperative images. (**a**) A: aorta; LIA: left iliac artery. (**b**) Balloon inflation at the left common iliac artery performing an "endoclamp".

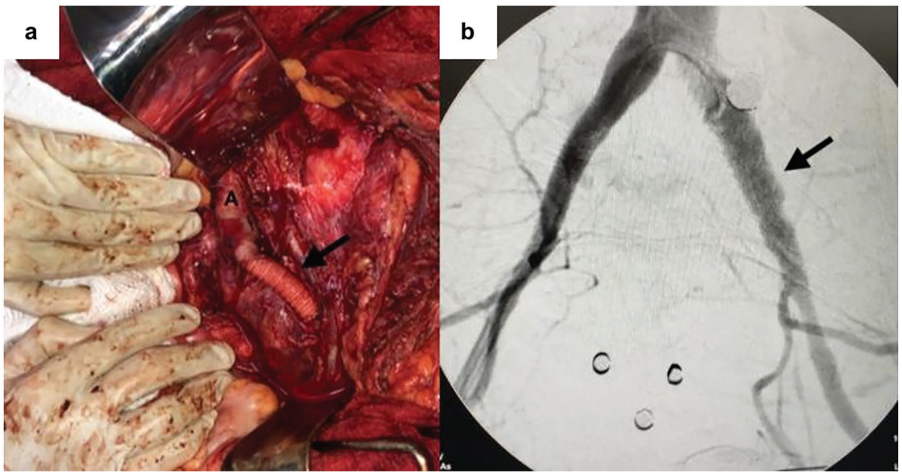

Figure 5 Intraoperative images. (**a**) A: Aorta. The arrow points towards the Dacron graft used for reconstructing the left common iliac artery. (**b**) Angiographic control demonstrating the patency of the reconstructed left common iliac artery/Dacron graft (pointed towards by the arrow).

An endoclap, in this case by inflating the balloon catheter over the fistula, diminishes the AFV pulsation and venous hypertension and, in the case of inadvertent vascular rupture while dissection is being performed, helps obtain hemorrhage control [7,13,15].

Intraoperative communication between surgical and anesthesiology teams is essential; the anesthesiologist team should be prepared to deal with the possibility of bradycardia and hypertension onset, suddenly after AVF occlusion (Nicoladoni–Branham sign), that can be clinically relevant [17,18].

CONCLUSIONS

Endovascular approaches have long been proved to lower complication rates associated with open exposures of complex traumatic AVFs, especially by reducing bleeding and the duration of the procedure.

When resource limitations preclude complete endovascular management, hybrid treatments may be useful. Preventing massive bleeding, preserving arterial flow and venous drainage and being prepared to deal with possible complications are the key points when performing these hybrid strategies.

Ethics Statement

(1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.

(2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Author Contributions

All the authors substantially contributed to the study and manuscript writing.

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