Introduction

Arteriovenous fistula (AVF) of the infrarenal aorta is a well known clinical entity, which left untreated carries a high mortality rate. They can occur secondary to erosion of either an abdominal aortic aneurysm (AAA) or common iliac artery aneurysms (CIAAs) into the adjacent vena cava.1–3) The reported incidence is 0.3%–1.5% of all patients undergoing surgical treatment for aorto-iliac aneurysms1–3) and 6.4%–8.8% among those operated on for ruptured aneurysms.1, 2, 4) Classic teaching describes AVF presenting with the triad of symptoms: congestive heart failure, a continuous abdominal bruit, and a pulsating abdominal mass. However, the clinical presentation can be subtle and varied leading to a lack of a preoperative diagnosis.2, 5) Consequently, massive bleeding can ensue intra-operatively. Therefore, an astute preoperative diagnosis can help in identifying optimal operative approaches and minimize intra-op blood loss. We present two cases of AVFs in which the lesion had been diagnosed preoperatively and each patient underwent a tailored repair technique.

Case Report

Case 1

A 55-year-old man presented to our emergency room complaining of low abdominal pain, right leg pain, and anuria for 12 hours. Physical examination demonstrated a soft, non-distended, nontender abdomen without palpable masses or bruits. His legs were non cyanotic. Of note, the patient was 167 cm tall and weighed 87 kg making deep palpation of the abdomen difficult. Urethral catheterization obtained 20 mL of gross hematuria. Non contrast abdominal and pelvic computed tomography (CT) showed an infrarenal AAA with bilateral CIAAs. Enhanced CT revealed a right common iliac artery aneurysm measuring 6 cm in diameter, which was abutting and possibly involving the common iliac vein. The aneurysmal wall was thin and the right iliac vein enhanced in the arterial phase (Fig. 1). The patient was hemodynamically stable with a normal chest X-ray. Nevertheless, an urgent operation was performed with a provisional diagnosis of AVF to a ruptured iliac artery aneurysm. Surgical

We present two cases of arteriovenous fistulas associated with aneurysms of the infrarenal aorta or common iliac artery. A definitive diagnosis is sometimes difficult given the varied and unclear presentation. However, with the correct preoperative diagnosis, mortality can be reduced. Both cases, being reported here, were diagnosed preoperatively and underwent alternate surgical repairs. One case was treated by aortic exclusion, whereas the second case was treated by primary closure of the fistula. Repair techniques were chosen based on acuity of presentation. Given our experience with these two cases, we conclude that direct closure is possible but dependent on the chronicity of the lesion.

Key words: arteriovenous fistula, surgical repair, ruptured aorto-iliac aneurysm

Surgical Repair of Arteriovenous Fistula Associated with Infrarenal Aorto-iliac Aneurysm: Report of Two Contrasting Cases

Norihiro Kondo, MD, Kenji Takahashi, MD, Susumu Takeuchi, MD, and Kazuo Ito, MD

We present two cases of arteriovenous fistulas associated with aneurysms of the infrarenal aorta or common iliac artery. A definitive diagnosis is sometimes difficult given the varied and unclear presentation. However, with the correct preoperative diagnosis, mortality can be reduced. Both cases, being reported here, were diagnosed preoperatively and underwent alternate surgical repairs. One case was treated by aortic exclusion, whereas the second case was treated by primary closure of the fistula. Repair techniques were chosen based on acuity of presentation. Given our experience with these two cases, we conclude that direct closure is possible but dependent on the chronicity of the lesion.

Key words: arteriovenous fistula, surgical repair, ruptured aorto-iliac aneurysm

INTRODUCTION

Arteriovenous fistula (AVF) of the infrarenal aorta is a well known clinical entity, which left untreated carries a high mortality rate. They can occur secondary to erosion of either an abdominal aortic aneurysm (AAA) or common iliac artery aneurysms (CIAAs) into the adjacent vena cava.1–3) The reported incidence is 0.3%–1.5% of all patients undergoing surgical treatment for aorto-iliac aneurysms1–3) and 6.4%–8.8% among those operated on for ruptured aneurysms.1, 2, 4) Classic teaching describes AVF presenting with the triad of symptoms: congestive heart failure, a continuous abdominal bruit, and a pulsating abdominal mass. However, the clinical presentation can be subtle and varied leading to a lack of a preoperative diagnosis.2, 5) Consequently, massive bleeding can ensue intra-operatively. Therefore, an astute preoperative diagnosis can help in identifying optimal operative approaches and minimize intra-op blood loss. We present two cases of AVFs in which the lesion had been diagnosed preoperatively and each patient underwent a tailored repair technique.

CASE REPORT

Case 1

A 55-year-old man presented to our emergency room complaining of low abdominal pain, right leg pain, and anuria for 12 hours. Physical examination demonstrated a soft, non-distended, nontender abdomen without palpable masses or bruits. His legs were non cyanotic. Of note, the patient was 167 cm tall and weighed 87 kg making deep palpation of the abdomen difficult. Urethral catheterization obtained 20 mL of gross hematuria. Non contrast abdominal and pelvic computed tomography (CT) showed an infrarenal AAA with bilateral CIAAs. Enhanced CT revealed a right common iliac artery aneurysm measuring 6 cm in diameter, which was abutting and possibly involving the common iliac vein. The aneurysmal wall was thin and the right iliac vein enhanced in the arterial phase (Fig. 1). The patient was hemodynamically stable with a normal chest X-ray. Nevertheless, an urgent operation was performed with a provisional diagnosis of AVF to a ruptured iliac artery aneurysm. Surgical
approach was a median laparotomy. After standard proximal and distal control, the aneurysm was opened. At this point, a large amount of venous blood pooled into the operative field from an AVF, measuring 3.0 cm × 1.0 cm, originating distal to the aortic bifurcation. Direct closure was attempted, however, the fistula wall was extremely fragile, similar in consistency to necrotic tissue. Given the lack of tissue integrity to support a surgical repair it was decided to close the aneurysmal wall and manage the AVF with an aortic exclusion procedure. The lumbar arteries were oversewn, and the aneurysm sac was closed. AVF bleeding was controlled by venous compression. The aneurysm sac was excluded by ligation and oversewing proximally and distally (Fig. 2). An anatomical reconstruction was performed with a 20-mm woven Dacron bifurcated graft (Fig. 2). His hematuria resolved almost immediately. However, the patient had a prolonged post operative course (53 days) complicated by a non mechanical intestinal obstruction, and he had no direct procedure-related complications. He did not require hemodialysis and no evidence was found to suggest deep vein thrombosis or pulmonary thromboembolism.

Case 2
A 66 year old man was referred to the Department of Cardiology at our institution for evaluation of a systolic abdominal bruit. He had no symptoms, but chest X-ray showed a right sided pleural effusion. Contrast enhanced CT showed an infrarenal AAA measuring 8.3 cm × 7.0 cm. The lesion was compressing the adjacent IVC, and there appeared to be contrast leakage into the inferior vena cava (Fig. 3). The patient was immediately transferred to our service and taken to the operating room for an emergent repair of the aneurysm. Our approach was a median laparotomy. The AAA was identified and proximal, and distal control was obtained. The aneurysmal sac was opened, the adherent thrombus was removed, and venous blood was noted to be pooling into the field. A 2 cm × 1 cm communication was identified between the aneurysmal wall and the vena cava. Venous bleeding was controlled by direct compression. The wall of the AVF was solid, thereby permitting direct closure with felt strip reinforcements. The patient had an uneventful post operative course and was discharged after 21 days.

Discussion
The overall incidence of AVFs is cited as 0.2% to 2.2% of all infrarenal aortoiliac aneurysms undergoing surgery.1–3 Aneurysmal erosion into the venous system is the most common etiology for communication between the
two systems. The erosion results from spontaneous rupture of an atherosclerotic aneurysm directly into the adjacent vein. The current theory behind the development of these fistulas is that pressure and tension from large aneurysms produce necrosis of the aortic wall. This results in an adventitial inflammatory reaction and recruitment of adjacent vein(s) to the diseased artery. The inflammation progresses until the arterial wall ruptures into the venous system, creating a fistula.

Diagnosing an AVF can be difficult because the classic signs (pulsatile abdominal mass with bruit and high-output heart failure) are present in only 20%–50% of reported cases. Patients with AVF present atypically with decompensated congestive heart failure occurring in only 35% of cases. As an example, our second patient had a chest X-ray with a right sided pleural effusion but was otherwise asymptomatic. Takazawa et al. reported the following as reasons for a delay in diagnosis: 1) shock often obscures symptoms when an immediate operation is needed 2) there is decreased shunt flow due to venous compression by large aneurysms 3) there is often-time partial obstruction of the AVF by mural thrombus. Such compression can compromise venous return to the heart and elevate peripheral venous pressures. This can manifest as swelling of the lower extremities, hematuria, renal insufficiency, scrotal edema, and even rectal bleeding. If attention is directed purely on these secondary symptoms, there will inherently be a delay in diagnosing and treating AVFs. This delay can be catastrophic given a mortality rate of 30%. The condition thus requires a prudent preoperative diagnosis and urgent repair. The quoted operative mortality rate of AVF repairs ranges from 16%–66%. This relatively high mortality rate is attributed to other co-morbidities as age, coronary artery disease and congestive heart failure.

Having the correct preoperative diagnosis can reduce intraoperative blood loss when performing an urgent AVF repair. Nevertheless, control of venous bleeding remains a challenge. Manual compression proximally and distally to the fistula is a useful maneuver. Alternatively, balloon occlusion via a transfemoral or transfistural insertion can be attempted. In the event of irretractable venous bleeding from the AVF, it may be necessary to ligate the IVC. The ideal approach to control...
bleeding would be to snare the proximal IVC and the distal portion of the AVF. However, this can be difficult given the adhesions between the arteries and the vein. This approach was attempted but abandoned in the present two cases considering the possibility of venous injury.

In the event of a friable wall, direct closure can be difficult. The exclusion method\(^6\) can be useful as it avoids manipulating the fragile fistula.

A potential complication of this method is deep vein thrombosis (DVT) as reported by Woolley and colleagues.\(^6\) A relationship might exist between venous thrombus and the thrombus in the excluded aortic segment.\(^6\) In our first case, the aneurysmal sac was filled with thrombus. However, the thrombus remained stable not to be dislodged from the cavity into the venous system. The clot would eventually become organized, and the venous opening would be closed with scar tissue.\(^4\) Venous thrombosis remains a reported complication after surgery for ruptured aortic aneurysms.\(^8\) Since DVTs can be multi-factorial, it is crucial to keep the venous system intact and implement standard DVT precautions. The possibility of direct closure might depend on the chronicity of the fistula. The present cases illustrate that closure should be avoided in the acute scenario (e.g., Case 1), while entertained in the chronic scenario (e.g., Case 2).

Because of its rarity and associated technical difficulties, AVFs presents a challenge to the vascular surgeon. However with an early preoperative diagnosis, minimization of blood loss and use of appropriate bypass techniques, satisfactory outcomes can be attained.

**Acknowledgements**

The authors thank Kevin Koomalsingh, MD, for his assistance in language editing.

**References**