

# Endovascular Treatment of High Output Heart Failure from Aortocaval Fistulas

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## Abstract

Aortocaval fistulas are a rare cause of high output heart failure. The infrequency with which it is encountered makes these fistulas a formidable diagnostic and treatment challenge. In the absence of infection, traditional repair with open surgical approach has required in-situ graft replacement of the affected portion of the aorta with concomitant repair of the cava defect. Mortality associated with open repair is reported to be as high as 66%. Technical advances in endovascular treatment of aortic aneurysms over the past two decades are increasingly used in other large vessel pathologies. This mini-review summarizes current evidence for employing endovascular techniques for aortocaval fistulas.

**Keywords:** heart failure; aortocaval fistulas; endovascular treatment

## Introduction

Arteriovenous shunting secondary to aortocaval fistulas (ACF) is an uncommon, yet treatable cause of high output heart failure. ACFs may develop as a result of trauma, iatrogenic injury, or abdominal aortic aneurysms (AAA) [1]. Most often, the diagnosis of ACF is made intra-operatively during urgent surgical exploration of a ruptured abdominal aortic aneurysm [2]. In other cases, ACF takes a more indolent course. In the initial presentation of a patient with jugular venous distension, peripheral edema, and pulmonary vascular congestion ACF is an important, albeit rare, diagnosis to consider. The clinical manifestations of aortocaval fistulas are a maladaptive response to shunting. Shunting results in a decrease of both peripheral vascular resistance and arterial pressure. In response, neurohormonal systems are activated triggering compensatory mechanisms that result in fluid overload, cardiac hypertrophy, and ultimately, cardiac failure [1, 2, 3]. Arteriovenous shunting resulting in high output heart failure has been associated with a 58% mortality at 5 years(3). The diagnosis of an ACF associated with an AAA is up to 67% [5]. Correcting the shunt results in an immediate clinical improvement, with a concomitant decrease in mortality [3]. While strides have been made in the pre-operative diagnosis of ACF, there is still difficulty in providing safe and effective treatment. Recent advances in endovascular therapy have expanded to include the treatment of aortocaval fistulas [6]. These include a total endovascular approach to repair, as well as a hybrid approach, such as open repair of AAA with endovascular occlusion of the inferior vena cava at the site of the fistula. A series of three patients at our institution, all of whom presented with high output heart failure, were successfully treated with stent grafting and immediate resolution of heart failure.

## Surgical Technique

The traditional treatment of ACFs involves surgery to expose and correct the anomaly. It is a morbid procedure with a mortality rate as high as 66%(5). Much of the morbidity is due to the extensive dissection necessary for exposure as well as the risk of hemorrhage associated with repair. These include iatrogenic injury to the small, friable, arterialized veins as well as the technical challenges associated while obtaining proximal and distal control of the thin-walled vena cava. If one chooses to forgo obtaining full control of the inferior vena cava, then the repair is even more treacherous due to potential bleeding from the site of the ACF at the vena cava.

Endovascular repair of ACF provides a minimally invasive approach to repair. It obviates the need for arterial and venous control, greatly decreasing the risk of blood loss. The armamentarium of endovascular treatments has evolved over last two decades to now include stent grafting within the aorta and/or IVC, interruption of the IVC, or a hybrid approach of open surgical and endovascular treatment. These allow surgeons to decrease the risk of hemorrhage and provide the opportunity for a less morbid procedure.

Parodi first successfully applied a stent graft to the treatment of aortic pathology in 1990 [7]. It is arguably the greatest innovation in vascular surgery in the modern era, one that surprisingly received little fanfare at first. The shift from open aortic aneurysm repair to endovascular repair has resulted in shorter hospital stays and decreased short-term mortality (1.8% EVAR vs. 4.3% open repair) [8]. The patient experience transformed from a midline laparotomy incision and minimum 5 day hospital stay to a small groin incision and overnight hospital visit. Since

its inception, stent grafting applications to vascular pathology have expanded exponentially.

Recent advances in the treatment of ACF reflect a mortality benefit from endovascular application. With the shift to pre-operative diagnosis of ACF, surgeons are granted the foresight needed to plan a complex endovascular or hybrid repair. The indications are the same for endovascular repair of aortic aneurysms and include suitable anatomy, adequate neck length and landing zone, as well as adequate access vessel caliber and quality. In the largest series investigating the treatment of ACF associated with AAA, an analysis of 67 patients showed a considerable 30-day mortality benefit with EVAR vs. open repair when excluding delayed diagnoses (3.8% vs. 12%) [9]. Open repair carried a 36% post-operative complication rate, including renal failure, DVT, and wound infection; endovascular repair had a complication rate of 50%. The majority of post op complications after endovascular intervention were type 2 endoleaks. Endovascular treatment requires continued surveillance to ensure complete resolution of the ACF, given the high risk of type 2 endoleak and potential persistence of flow through the ACF.

Short-term analysis reveals a significant survival benefit of ACF treated with endovascular compared to open repair. Antoniou et al reviewed 22 cases of endovascular stent-graft repair of abdominal AV fistulas with 0% mortality at 30 days. The most common complication was type 2 endoleak (22%) of which the majority spontaneously resolved [10]. In comparison, the mortality associated with surgical repair of ACF ranges from 10%, for those diagnosed pre-operatively, to 50%, for those diagnosed intra-operatively. Similar to traditional open vs EVAR repair of AAA in the EVAR1 trial, there is a short-term mortality benefit of EVAR. The long-term morbidity and mortality benefit of endovascular repair is less clear, as the risk of sac expansion and continued patency of the ACF due to endoleak is significant. In our case series of three patients, all three underwent endovascular repair of ACF with 100% survival up to 10 years out from intervention. One out of three patients required reintervention for endoleak with continued flow through ACF.

## Conclusion

Endovascular treatment of aortocaval fistula is already adopted at many institutions with surgical expertise and hybrid operating room availability. When the ACF is diagnosed pre-operatively, the surgery team has time to properly assess the patient and determine their suitability for endovascular

repair. Current evidence show both short and long term mortality benefit when the intervention is technically successful.

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