A Rare Case of Traumatic Innominate-Innominate Arteriovenous Fistula

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Patient: Male, 23-year-old
Final Diagnosis: Traumatic innominate-innominate arteriovenous fistula
Symptoms: High output cardiac failure
Medication: —
Clinical Procedure: —
Specialty: Cardiac Surgery • Cardiology • General and Internal Medicine

Objective: Rare disease
Background: This report presents a rare case of a traumatic innominate artery to left innominate vein fistula following a stab wound to the base of the neck. Examination revealed a wide pulse pressure, bounding pulses, and a continuous murmur on the upper sternal area. Chest X-rays, echocardiography, CT angiography, and cardiac catheterization were useful to aid in diagnosis and work-up for fistula repair. A complex 8-mm fistula between the left innominate vein and the proximal innominate artery was noted, with multiple tortuous channels and demonstrating a reversible left-to-right shunt. After medical optimization, successful surgical ligation and division of the fistula was done through median sternotomy without cardiopulmonary bypass. The postoperative recovery was uneventful.

Conclusions: Traumatic innominate-innominate arteriovenous fistulas are rare and can pose a diagnostic challenge. High index of suspicion, careful history, examination, and radiologic evaluation usually result in correct diagnosis. Endovascular and surgical approaches are the mainstay treatment.

Keywords: Advanced Trauma Life Support Care • Aorta, Thoracic • Arteriovenous Fistula

Full-text PDF: https://www.amjcaserep.com/abstract/index/idArt/934270
Background

Traumatic arteriovenous fistulas with proximal aortic branch feeding vessels are rare but usually symptomatic [1]. Symptoms of high-output cardiac failure in patients with a history of penetrating trauma should raise the suspicion of an arteriovenous fistula. The protection of the innominate vessels by the sternum may be the reason for the less frequent occurrence of fistula, as no innominate artery feeding vessels were observed in one of the largest studies on traumatic arteriovenous fistula [1]. To the best of our knowledge, the exact incidence of innominate-innominate arteriovenous fistula is unknown.

Case Report

We report the case of a 23-year-old male patient with previous history of penetrating trauma to anterior zone 1 of the neck 3 years prior. The patient was stabbed with a knife in the suprasternal notch, with resultant profuse bleeding. Upon presenting at a local hospital emergency room, the bleeding was initially controlled with pressure dressings. Blood investigations and chest X-rays were largely unremarkable, with no documented reason for omission of a CT scan. Local exploration of the wound was done, which revealed low-pressure venous bleeding, which was controlled with a combination of deep absorbable and superficial non-absorbable sutures. However, the exact source of the bleeding was not documented. After a day of observation, the patient was discharged with no symptoms, and there was no documented radiological or clinical follow-up. On the current presentation, the patient had symptoms of heart failure with progressive fatigue, palpitations, dyspnea on exertion (New York Heart Association class 3), and bilateral ankle swelling over a period of 5 months. Examination revealed tachycardia, tachypnea, wide pulse pressure, bounding pulses, hyperactive precordium, systolic thrill with a systolic murmur at the upper sternal area, and a crescendo apical runoff diastolic murmur, accentuated P2 consistent with pulmonary hypertension, but no cyanosis. The differential diagnosis included severe aortic regurgitation, ruptured sinus of Valsalva aneurysm, delayed presentation of a patent ductus arteriosus, and pulmonary or cardiac arteriovenous fistula. An electrocardiogram showed sinus tachycardia, bialtric enlargement, left ventricular hypertrophy of the overload type, with deep Q waves and tall R waves in the left precordial leads. Chest X-rays showed cardiomegaly and a homogenous opacity in the anterosuperior mediastinum, with well-defined lateral convex borders. On lateral X-ray, the same opacity was noted to occupy the pretracheal space, above the cardiac shadow and posterior to the upper sternum (Figure 1). An echocardiogram showed 4-chamber dilatation, ejection fraction of 50%, functional moderate mitral and tricuspid regurgitation, and severe pulmonary hypertension at rest. The suprasternal view, in particular, showed multiple tortuous fistulous tracts between the innominate artery and the left innominate vein with left-to-right shunt. CT angiography revealed aneurysmal (varicose) left and right innominate veins abutting the posterior table of the sternum (Figure 2). A fistula was also noted between the left innominate vein and the innominate artery at its origin from the aortic arch. Considering that the patient had severe pulmonary hypertension, cardiac catheterization was done. It showed an 8-mm complex fistula with multiple

![Figure 1. PA (A) and lateral (B) chest X-rays of the patient showing an opacity in the anterosuperior mediastinum, and the assumed direction of the stab (white arrow on lateral X-ray).](image-url)
tortuous channels, with left-to-right shunting through it and a severely raised pulmonary artery systolic pressure (PASP). The PASP declined significantly on 100% oxygen, highly predictive of reversible pulmonary pressures upon closure of the fistula. A combination of echocardiography, CT angiography, and conventional angiography were used to outline the anatomy of the fistula. After medical optimization, surgical ligation and division of the fistula were done via a median sternotomy without cardiopulmonary bypass. The patient had an uneventful recovery and remained asymptomatic on follow-up, with normal serial clinical examinations.

Discussion

The occurrence of traumatic systemic arteriovenous fistula is well documented, occurring in 7% of arterial injuries [1]. However, involvement of the retrosternal innominate artery and aortic fistula are rare. The theoretical protection from the sternum may be the reason for such a rarity. There was no documentation of the innominate artery as a feeding vessel in one of the most recent and largest systematic review of traumatic arteriovenous fistulas [1].

In our case, a possible theoretical injury trajectory was that of a steep, almost vertical, anteroposterior and posterior direction from the suprasternal notch (white arrow on Figure 1). After penetrating the skin and subcutaneous tissues and muscles, there was a through-and-through injury of the anterior and posterior walls of the left innominate vein, while only the anterior wall of the innominate artery was breached. A small initial fistula, the proximity of both vessels, a soft-tissue flap acting as a one-way valve tamponade effect of surrounding thymic tissue, and a mediastinal hematoma may have contributed to the initial patient stability without exsanguination. After fistula maturation due to fibrosis of the edges to form established fistula walls, progressive increase in the amount of left-to-right shunt resulted in development of symptoms.

The pathophysiology and presentation of a systemic arteriovenous fistula is related to the amount of left-to-right shunt, its size and direction, underlying cardiac pathology, the relative resistances, and pressure differences between the systemic and venous systems [2]. This is analogous to the pathophysiology of patent ductus arteriosus [3], which is also mimicked by pulmonary arteriovenous malformations, aortoventricular tunnel, ruptured sinus of Valsalva aneurysm, ventricular septal defect with aortic regurgitation, and aortopulmonary window, among others [3]. The determinants of heart failure presentation as in our case include a large-diameter feeding vessel, longer period from time of injury to presentation, and a feeding vessel more proximal to the aorta [1,4]. Clinical clues to the diagnosis include a high index of suspicion, heart failure signs and symptoms, pulse features of a diastolic runoff, and a continuous murmur.
The management options are medical, interventional, and surgical [5]. Medical therapy is mainly for stabilization of patients presenting with high-output heart failure [6]. Although there is a small role for definitive medical management of small traumatic fistula, repair is the mainstay management in the majority of cases [5]. Endovascular options such as stents, plugs, and coils are more attractive due to less morbidity compared to surgery [5]. Moreover, endovascular approaches result in minimal blood loss, less pain, and early recovery, among other advantages. However, our case was managed surgically due to unsatisfactory proximal landing zones for stent deployment, as well as multiple complex fistulous tracts deemed not ideal for device closure. Due to the proximity of the innominate veins to the sternum, inadvertent injury to the veins during sternotomy is a potentially fatal complication during surgery. Cardiopulmonary bypass can be used as an adjunct when unsafe sternal entry is anticipated. Although our case was done off-bypass, we had cardiopulmonary bypass on standby in the surgical theater with exposed femoral vessels prior to sternotomy.

The follow-up after surgical fistula division and ligation is by an initial baseline radiology and serial clinical examinations for resolution of symptoms. For endovascular fistula closure, multiple radiological follow-ups with CT angiography for prolonged durations may be necessary for identification of fistula recurrence and stent complications.

**Conclusions**

Traumatic innominate-innominate arteriovenous fistula may mimic a patent ductus arteriosus. Careful history-taking, examination, and appropriate radiological evaluation aid the diagnosis. Management options include endovascular and surgical approaches after initial medical stabilization of high-output heart failure.

**Declaration of Figures’ Authenticity**

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