

# Endovascular Repair of Acquired Aortopulmonary Shunt after Shotgun Injury

Enrico Mancuso<sup>1</sup>, Vasco Gama Ribeiro<sup>2</sup>, Cesare Quarto<sup>1</sup> and Christoph A Nienaber<sup>1\*</sup>

<sup>1</sup>Imperial College, Royal Brompton Hospital, Cardiology and Cardiothoracic Surgery, London, SW3 6NP, UK

<sup>2</sup>Cardiology Department, Centro Hospitalar de Gaia, Portugal

## Article Information

Received date: Jul 28, 2016

Accepted date: Aug 15, 2016

Published date: Aug 22, 2016

### \*Corresponding author

Christoph A. Nienaber, MD, FESC, FACC Royal Brompton Hospital, Cardiology and Aortic Centre, Sydney Street London, SW3 6NP United Kingdom, Tel: +44 20 7352 8121; Email: c.nienaber@rbht.nhs.uk

**Distributed under** Creative Commons CC-BY 4.0

**Keywords** Aortopulmonary Shunt; Aorta; Pulmonary Artery; Endovascular Stent; Aortic Injury; Chest Injury; Thorax Trauma; Vascular Imaging

**Abbreviations** LV: Left Ventricle; LVEF: Left Ventricle Ejection Fraction; MR: Magnetic Resonance; CT: Computer Tomography

## Abstract

Endovascular procedures are being progressively utilized for a variety of vascular pathologies of great vessels of the thoracic cage including aneurysm, dissection and post-traumatic injuries [1-4]. Endovascular stent-grafting for an acquired shunting between great vessels in the thoracic cage after a traumatic injury, however, constitutes a rare non-surgical treatment concept [5]. This case of chronic aortopulmonary shunt condition induced by shotgun injury exemplifies not only the successful percutaneous seal and separation of both the arterial and pulmonary circulation in the chest without surgery, but also the complete recovery of haemodynamics and left ventricular function 13 years after acquired aortopulmonary shunt.

## Introduction

Aorto-pulmonary arterial fistula is an uncommon complication of aortic lesions [6-7]. Nowadays these are a late complication of dissected or atherosclerotic chronic aneurysms and most frequently located in the ascending aorta and rarely in the descending aorta [8].

The clinical presentation is usually a congestive heart failure due to high flow left to right shunt [9].

A post-traumatic aorto-pulmonary shunt is a rare complication of chest injuries [10]. On a series of five hundred and eleven patients with penetrating or perforating chest injuries reviewed by S. Mattila et al. During 25-year-period, only one of them had an aorto-pulmonary fistula that required open-heart surgery repair [11]. Hitoshi Hirose et al. Described a late presentation of an aorto-pulmonary shunt, where a fistula through a post traumatic aneurysm of the descending aorta into the pulmonary artery was repaired via left thoracotomy and hypothermic bypass [10].

Kroll W et al. Reported a case of aortopulmonary shunt after a knife injury [12]. The complexity of a late diagnosis was demonstrated and also in this case open-heart surgery was necessary [11].

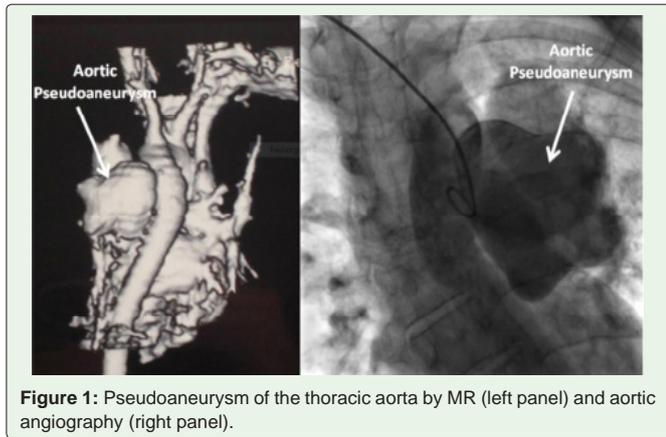
We present a case report of a 34 year old man with a late presentation of a fistula between the descending aorta and the pulmonary artery secondary to a shotgun injury to the chest, successfully treated with an endovascular approach.

## Case presentation

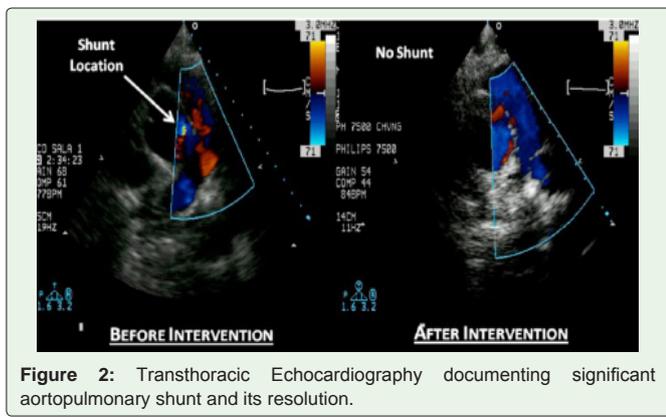
A 21 year old man survived a shotgun injury to his left hemithorax which caused a bullet-induced destruction of T6 vertebral body with resulting complete paraplegia. At the time of his trauma no cardiovascular disorder was identified, but after recovering he slowly developed cardiac failure.

At the age of 25 he was found with a continuous murmur on physical examination and MR angiography of his chest revealed a partially calcified post-traumatic aortic pseudoaneurysm (figure 1 - left panel), with a maximum diameter of 7 cm and a mid size aortopulmonary fistula to the main pulmonary artery with arterial blood shunting into the pulmonary circulation; this finding was subsequently confirmed by contrast aortography (figure 1 - right panel).

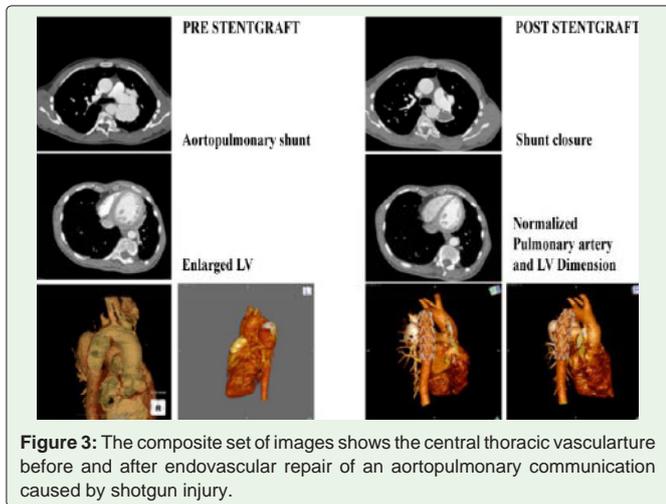
Transthoracic echocardiography confirmed pulmonary artery dilation and expansion with accompanying left ventricular overload (LV end-diastolic diameter 65 mm), resulting from increased circulatory volume, and mildly reduced left ventricular systolic function (ejection fraction 41%). Colour-Doppler interrogation demonstrated a high velocity left-to-right shunt (peak velocity of 4.38 m/s and a peak gradient of 77 mmHg) into the aorta to the main pulmonary artery (figure 2). Although the patient was presented to two cardio-thoracic centres, he was denied surgical treatment after risk assessment (surgery to central great vessels on cardiopulmonary bypass in a paraplegic patient).



**Figure 1:** Pseudoaneurysm of the thoracic aorta by MR (left panel) and aortic angiography (right panel).



**Figure 2:** Transthoracic Echocardiography documenting significant aortopulmonary shunt and its resolution.



**Figure 3:** The composite set of images shows the central thoracic vasculature before and after endovascular repair of an aortopulmonary communication caused by shotgun injury.

At the age of 34 year old, because of deterioration of cardiac failure, a team decision was made to treat the left-to-right shunt endovascularly. In view of the circumscribed nature of the bullet-induced fistula between the aortic pseudoaneurysm and the pulmonary artery, endovascular repair was attempted by placing a 10 cm Valiant endoprosthesis (28x100 mm) to cover the aortopulmonary communication. Percutaneous right femoral artery access in local anaesthesia was used and both the high and low pressure circulatory systems were successfully separated with complete sealing of the aorto-pulmonary communication. Femoral access was closed using a percutaneous closure device.

Hemodynamic pressure recordings documented successful separation of arterial and pulmonary circulation and oximetry indicated significant reduction of pulmonary artery pressure and complete abolition of shunt. Patient was discharged within 3 days followed by rapid and complete recovery from cardiac failure with a stable course over 3 years. Standardized follow-up CT 5 after endovascular repair confirmed correct placement of the endovascular prosthesis, and sustained separation of aortic and pulmonary circulation with significant reduction on LV volume and normalized LVEF (figure 3).

**Conclusion**

This case report documents the feasibility of percutaneous endovascular closure of an acquired aorto-pulmonary shunt caused by shotgun injury, with complete restoration of hemodynamic and vascular integrity. Endovascular repair avoids thoracotomy and general anaesthesia for repair of major shunts from great vessel shotgun injury and has proven to restore normal pulmonary and arterial circulation by non surgical means.

**References**

- Hiratzka LF, Bakris GL, Beckman JA, Bersin RM, Carr VF, Casey DE, et al. ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM - Guidelines for the Diagnosis and Management of Patients with thoracic Aortic Disease: Executive Summary. *J Am Coll Cardiol.* 2010; 55: 1509-1544.
- Coady MA, Ikonomidis JS, Cheung AT, Matsumoto AH, Dake MD, Chaikof EL, et al. American Heart Association Council on Cardiovascular Surgery and Anesthesia and Council on Peripheral Vascular Disease. Surgical Management of Descending Thoracic Aortic Disease: Open and Endovascular Approaches. A Scientific Statement from the American Heart Association. *Circulation.* 2010; 121: 2780-2804.
- Svensson LG, Kouchoukos NT, Miller DC, Bavaria JE, Coselli JS, Curi MA, et al. Society of Thoracic Surgeons Endovascular Surgery Task Force. Expert consensus document on the treatment of descending thoracic aortic disease using endovascular stent-grafts. *Ann Thorac Surg.* 2008; 85:1-41.
- Xenos ES, Abedi NN, Davenport DL, Minion DJ, Hamdallah O, Sorial EE, et al. Meta-analysis of endovascular vs open repair for traumatic descending thoracic aortic rupture. *J Vasc Surg.* 2008; 48: 1343-1351.
- Nienaber CA, Kische S, Skriabina V, Ince H. Noninvasive Imaging Approaches to Evaluate the Patient with known or suspected Aortic Disease. *Circ Cardiovasc Imaging.* 2009; 2: 499-506.
- Boyd LJ. A study of four thousand reported cases of aneurysm of the thoracic aorta. *Am J Med Sci.* 1924; 168: 654-668.
- Nicholson RE. Syndrome of rupture of aortic aneurysm into the pulmonary artery: review of the literature with report of two cases. *Ann Intern Med.* 1943; 19: 286-325.
- Coselli JS, Le Maire SA, Van Cleve GD. Rupture of a dissecting thoracic aortic aneurysm into the pulmonary artery: successful surgical repair. *Cardiovasc Surg.* 1995; 3: 697-701.
- Takahashi A, Uchida T, Kim C, Maekawa Y, Miyazaki R, Mizumoto M, et al. Aortopulmonary fistula caused by aortic arch aneurysm rupture presenting severe left to right shunt and congestive heart failure. *Kyobu Geka.* 2013; 66: 532-536.
- Hitoshi Hirose, Lars G. Svensson. Chronic posttraumatic aneurysm of descending aorta with fistulous communication into pulmonary artery. *J Vasc Surg.* 2004; 40: 564-566.
- S. Mattila, E. Laustela, and P. Tala. *Scandinavian Journal Of Thoracic And Cardiovascular Surgery* Vol. 1981; 15: Iss 1.
- Kroll W, Nellessen U, Herrmann G, Kaatsch HJ, Regensburger D, Simor R. An aortopulmonary shunt after a knife injury *Dtsch Med Wochenschr.* 1992; 117: 619-622.