# Near complete aortic transection and its successful repair using a novel cardiopulmonary bypass technique

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## Abstract

The case of a 38-year old female, victim of a road traffic accident who presented with a near complete aortic transection is presented. An emergent repair employing cardiopulmonary bypass was attempted in the operating room. Anticipating a high-risk of compromise to cerebral perfusion from air micro-emboli, the bypass was attempted with an innovative approach involving the successful cannulation of the pulmonary artery and descending aorta. The patient survived and was found to be doing well on subsequent post-operative visits.

**Keywords:** Air emboli, Aortic transection, Cardiopulmonary bypass, Micro emboli, Pulmonary artery.

## Introduction

Aortic transection is a rare injury and results from blunt trauma to the thoracic cage. Only, 15-20% of patients survive the trip to the hospital.[1]

The use of heparin-less cardiopulmonary bypass has led to a significant decrease in morbidity and mortality compared to the conventional clamp and sew technique and passive shunting technique in patients with traumatic aortic rupture. Cardiopulmonary bypass techniques have been extensively studied and honed to improve patient safety. However, rare complications such as an air-emboli are often difficult to prevent in high risk procedures.[2]

Since cardiopulmonary bypass is generally carried out via the cannulation from the left atrium and the descending aorta, there exists a risk of micro-emboli escaping into the cerebral circulation.[2] Despite being rare, cerebral micro- and macro- emboli consisting of air have been found to be associated with cardiopulmonary bypass and can produce grave neurologic sequelae.[3]

In this report, we describe a rare case of a near-complete aortic transection that was successfully managed by a novel cardiopulmonary bypass technique that involved the cannulation of pulmonary artery and the descending aorta.

## Case Report

A 38-year old female presented to the emergency department after a car crash that had claimed the lives of three family members. At the time of presentation, she was found to be haemodynamically stable however radiological investigations revealed multiple injuries including fracture of the right distal femur, facial contusions, bilateral rib fractures and a left haemothorax. She also had a widened mediastinum on a portable chest X-ray. A CT-scan of the chest was performed which showed an aneurysmal swelling at the confluence of aortic arch and descending aorta with clear evidence of transection at the level of the isthmus.

The patient was emergently taken to the operating room. The aortic arch and the descending aorta were exposed via a left postero-lateral thoracotomy. The aorta was mobilized up to the diaphragm. The pericardium was opened and patient was placed on partial cardiopulmonary bypass via cannulation of the descending aorta and pulmonary artery.

After proximal and distal control, the pseudo aneurysm

**Figure-1:** A snapshot of the lesion visualized at the descending aorta.

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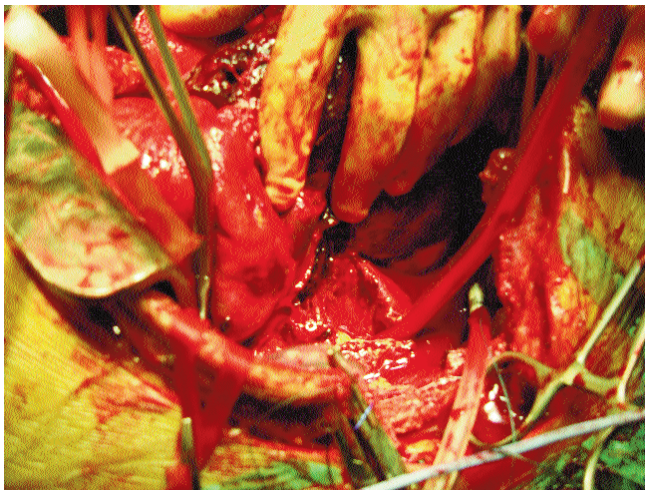

**Figure-2:** The freshened proximal and distal edges of the aortic tear prior to repair.

around the isthmus was opened. The aorta was more than 90% transected (Figure-1). It was remarkable to note that she was able to survive, despite such massive transection of the aorta. The edges were freshened and the proximal and distal ends were brought together with the help of 4-0 Prolene (Figure-2). There were no intra-operative or post-operative complications. The patient's femur was fixed with internal fixation by orthopaedics prior to discharge. The patient has been doing well on post-discharge follow up visits.

## Discussion

Cardiopulmonary bypass has been established as an effective technique in the repair of aortic transections.[4] It has a variety of advantages which include decreasing incidence of spinal cord damage and paralysis, decreased time constraints of aortic cross-clamping and protection against left ventricle and lung bed and controlling hypothermia relative to other techniques used for the repair of aortic ruptures.[2] Cannulation from the left atrium to the descending aorta distal to the transection is the most common type of cannulation for aortic repair.

The incidence of paraplegia from cardiopulmonary bypass ranges from 2.3-3.2%.[2] Studies utilizing the Emboli Detection and Classification (EDAC) Quantifier have reported 1,000 microemboli per second from cardiopulmonary bypass at flow rates ranging from 0.2 L/min to 6.0 L/min.[5] Air bubbles that are introduced into left heart by the use of cardiopulmonary bypass can travel along the aorta into the cerebral arteries and can cause neurologic sequelae. Severe air embolism occurs in 0.003% to 0.007% cases of cardiac bypass surgeries. If air emboli moves into the cerebral arteries it causes, confusion, seizure, transient ischaemic attack, and stroke.[6,7] The number of microemboli infiltrating the middle-cerebral-artery during surgery has been implicated in the development of neuropsychiatric complications suggesting a possible role of these in the causation of serious neurologic complications such as paraplegia.[5] In addition, cardiopulmonary bypass induces oxidative stress via the activation of pro-inflammatory pathways which can in turn cause multi-organ damage.[8]

Due to the severity of her injuries, our patient was at a higher risk of developing complications from the cardiac procedure. Cerebral air embolism was one of those feared complications. A number of cannulation techniques for cardiopulmonary bypass in aortic rupture patients have been described. In contrast to conventional practice, cannulation of the ascending aorta or the pulmonary and systemic vessels to the descending aorta have also been reported.[4] In this patient, we used a novel approach of cardiopulmonary bypass of cannulating the pulmonary artery and the descending aorta, diverting the path of emboli away from the cerebral circulation. The patient was stable and was doing well post-operatively and after hospital discharge.

## Conclusion

Our unconventional cardiopulmonary bypass technique was surprisingly successful at preventing complications in this high-risk procedure. This hints towards a new-avenue of cardiopulmonary bypass techniques among high risk patients.

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