Surgical repair of pulmonary vein injury from blunt trauma

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ABSTRACT Pulmonary vein deceleration injury is rare and patients can be deceptively stable for a period after injury. Quick diagnosis and transfer to the operating theatre is the only way to treat this potentially lethal injury successfully. Techniques of repair are a useful addition to the cardiovascular surgeon's repertoire.

KEYWORDS

Pulmonary vein – Left atrial wall – Left atrium – Deceleration injury – Cardiopulmonary bypass

Accepted 22 October 2014; published online XXX

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Case History

A 24-year-old male car driver was admitted following a head-on collision with a tree at unknown speed. The front seat passenger was pronounced dead at the scene. (Neither were wearing seatbelts.) On extraction from the car, the driver had a Glasgow coma scale score of 3 so he was intubated and stabilised with a blood pressure of 125/80mmHg and a pulse rate of 90bpm. In the emergency room, a right haemothorax was diagnosed and a chest drain inserted. Two litres of blood were drained and computed tomography showed a right haemopneumothorax (Fig 1), an undisplaced left lateral clavicular fracture, left inferior pubic ramus and acetabular fractures. Owing to continued drainage from the right chest requiring massive colloid transfusion, he was taken to theatre for definitive treatment.

The patient was positioned in the right thoracotomy position and via the sixth intercostal space, copious amounts of clot were evacuated. Bleeding from the inferior pulmonary vein was identified with partial avulsion of the vein from the left atrium. No other intrathoracic injuries were identified. The decision was made to repair this on cardiopulmonary bypass (CPB). With the right hilum packed with swabs, the right groin was exposed and the right common femoral artery and vein were identified. CPB was commenced via a 22Fr Thin-Flex single stage venous cannula (Edwards, Irvine, CA, US) in the right femoral vein and the return was via a 16Fr Fem-Flex II (Edwards) in the right femoral artery.

A curved DeBakey clamp was applied to the left atrium; the right main pulmonary artery was snared to ensure a bloodless field and further assessment showed a complex avulsion of the right inferior pulmonary vein extending into the left atrium, which was almost completely circumferential. The tip of the tear reached just beneath the right superior pulmonary vein. In order to improve venous return and

decompress the heart, a two-stage venous cannula was placed in the right atrium and connected to the femoral vein cannula via a Y-connector. The ascending aorta was cross-clamped and under cardioplegic arrest, the left atrial clamp was removed to allow further assessment. It confirmed the complex nature of the pulmonary vein avulsion.

The inferior vein was avulsed almost circumferentially with extension to the superior vein and also into the left atrium. The intra-atrial tear was repaired primarily and a porcine pericardial patch (Vascutek, Inchinnan, UK) was used to repair the anterior part of the avulsion on the left atrium, maintaining patency to the right inferior pulmonary vein (Fig 2). After routine deairing manoeuvres, the cross-clamp was removed, the patient weaned off bypass, decannulated (Fig 3) and the thoracotomy closed over two drains (Fig 4). He was transferred to the intensive care unit in a stable condition.

Discussion

Blunt chest trauma has been shown to occur in up to 50% of fatal road traffic accidents, being the primary cause of death in 12–25% of cases.¹ Pulmonary vein deceleration injury is rare² but was famously determined to be the cause of Princess Diana's death in 1997.³

Patients can be deceptively stable after a pulmonary vein rupture as the left atrium and pulmonary venous circulation is a low pressure, low impedance system.² The resulting low pressure haemothorax in the pleural cavity effectively functions as a giant left atrium, allowing the maintenance of haemodynamics.² Retention of the haemothorax in the pleural cavity without drainage and manoeuvres such as drain clamping or blocked drains due to clot is cited as a reason why patients survive to operative repair of this injury.² The collapsed lung around the hilum with

PTx = pneumothorax; RL = right lung; LL = left lung; HTx = haemothorax

Figure 1 Preoperative computed tomography showing the collapsed right lung with a haemopneumothorax and chest drain in situ

RLL = right lower lobe; RML = right middle lobe; RUL = right upper lobe; RA = right atrium; LA = left atrium

Figure 2 Intraoperative photograph showing the patch repair of the left atrium through a right thoracotomy

haemothorax (Fig 1) probably saved our patient, preventing immediate exsanguination, allowing time for resuscitation, assessment and transfer to theatre for definitive treatment.

Figure 3 Intraoperative photograph showing the right femoral artery after repair of the cannulation site via a right groin crease incision

CD = chest drain

Figure 4 Postoperative chest x-ray showing the fully re-expanded lungs with chest drains in situ

When the extent of the injury was discovered on thoracotomy, it became obvious that CPB with cardioplegic arrest would be required for repair. Total examination and repair of the heart and great vessels is easier with CPB because of the bloodless field, decompressed heart and reduced risk of increasing coagulopathy due to blood loss and/or massive transfusion.⁴ Access to the right femoral vessels in the right thoracotomy position and femorofemoral CPB was straightforward (Fig 3). A right atrial two-

stage cannula was also inserted to improve venous drainage and decompress the heart to facilitate repair.

Conclusions

Quick diagnosis and transfer to the operating theatre is the only way to treat this potentially lethal injury successfully. Techniques of repair are a useful addition to the cardiovascular surgeon's repertoire.

References

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