

Traumatic rupture of the aorta: a case report and discussion of clinical features

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Abstract

A young female patient was involved in a head-on collision and sustained a rupture of the aortic isthmus. She underwent emergency surgical repair of an aortic pseudoaneurysm with an interposition graft. She made a good post-operative recovery and represents the first such case in Malta.

Keywords

Traumatic aortic rupture, surgery

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Case report

A 29 year old woman was admitted to the emergency department following a motor vehicle accident. She was a front seat passenger involved in a head-on collision with an on-coming car. She did not wear a safety belt and the vehicle did not have airbags.

Her symptoms included upper chest pain and dyspnoea. Examination revealed a pale and distressed, obese patient (body mass index 34.4), with superficial lacerations on the forehead and a deep laceration on the peroneal aspect of the right lower leg. Breathing was shallow and air entry was diminished on the left side. All pulses were present and there was no neurological deficit. Blood pressure (BP) was measured in the right arm at 140/100mmHg.

Chest X-ray revealed a widened upper mediastinum with tracheal shift to the right, and a left-sided pleural fluid collection. The left 3rd and 4th ribs were fractured in two areas and displaced, while the left 7th and right 2nd ribs were fractured in their lateral portion (Figure 1).



Figure 1. Widened upper mediastinum. Chest drain in situ.

A contrast CT scan confirmed these fractures, as well as a comminuted left scapular fracture, and also revealed minor lung contusions. Just distal to the origin of the left subclavian artery there was an aortic

pseudo-aneurysm which extended for a few centimeters. There was a mediastinal haematoma surrounding the upper trachea and aortic arch and its branches (Figure 2).



Figure 2. CT chest showing massive mediastinal haematoma and flap within descending aorta.

A left chest drain was inserted in the emergency department and this drained 200ml of blood. A right radial arterial line was sited for real-time blood pressure monitoring and arterial blood gas analysis. A glyceryl trinitrate (GTN) infusion was administered in an attempt to reduce her blood pressure to under 100mmHg systolic but this goal was not achieved.

She was immediately taken to the operating theatre where she was anaesthetised by a rapid sequence induction. She was intubated with a left-sided double-lumen tube to enable collapse of the left lung. After induction a right femoral arterial line and right jugular 4-lumen and Percutaneous Swan Introducer sheath were inserted. There was a loss of systolic peak pressure in the right femoral artery as compared with the right radial artery tracing (Figure 3).

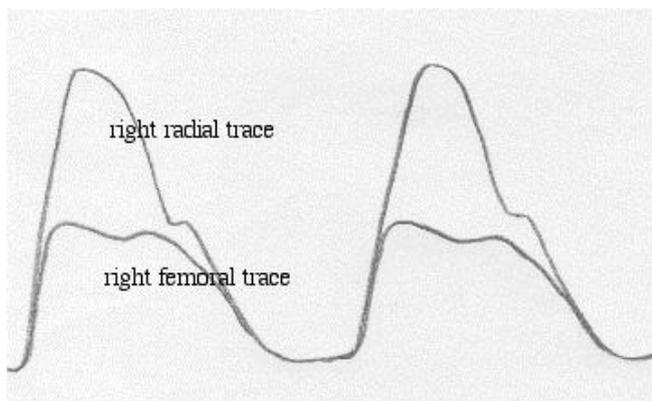


Figure 3. Simultaneous wave forms in right radial and right femoral arteries.

She was administered methylprednisolone 500mg to protect from spinal cord injury and 10,000units heparin iv to achieve an activated clotting time of twice baseline. The pleural cavity was entered via the 2nd intercostal space by means of a high left posterior thoracotomy with division of the 3rd rib. Clinical suspicion of contained aortic rupture was confirmed by a large haematoma surrounding the arch and descending aorta, and completely obliterating the aorto-pulmonary window (Figure 4a).

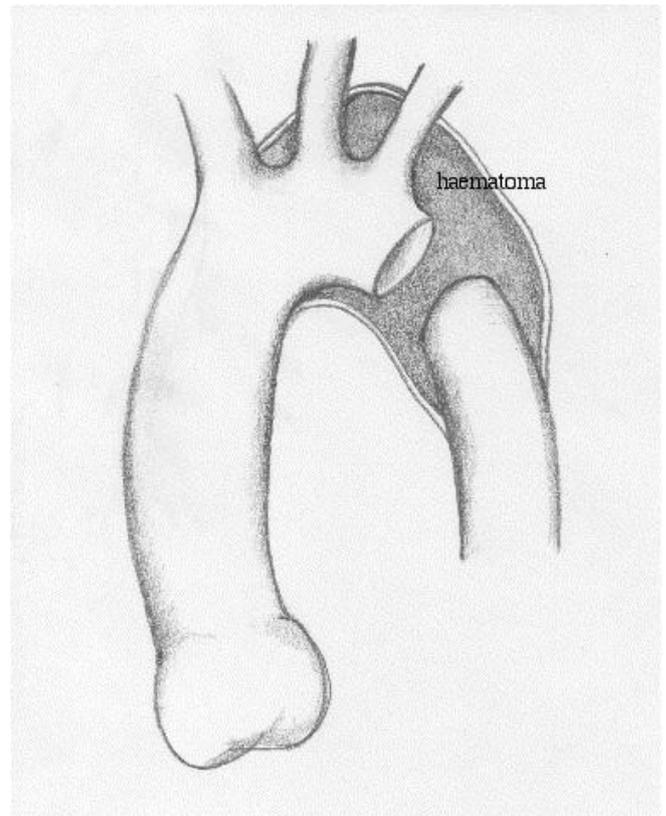


Figure 4a. Schematic representation of circumferential tear and contained haematoma.

The left subclavian artery was identified and encircled with a nylon tape. Dissection then proceeded proximally towards the left carotid origin. The aorta was encircled with a tape between the left carotid and subclavian arteries. At this point there was profuse haemorrhage into the pleural cavity and a Satinsky clamp was expeditiously applied to the aortic arch following the nylon tape. A straight clamp was applied distally across the descending aorta to secure haemostasis. The 1.2 litre blood loss was later auto-transfused using a cell saver. Further dissection revealed a circumferential tear of the aorta 1cm distal to the subclavian with a dissection extending 5mm proximally and 2cm distally. The aorta was trimmed proximally and distally until clean edges were encountered and the resulting 3cm gap bridged with

an 18mm Dacron tube graft (figure 4b). The prosthesis was sutured with continuous 4.0 Prolene, the proximal anastomosis buttressed with a Teflon strip and both suture lines coated with Tisseel (Baxter) fibrin sealant. Aortic clamping lasted 50 minutes, during which time the distal perfusion pressure was 10-15mmHg (measured via the right femoral cannula) and the proximal pressure (measured via the right radial cannula) controlled at 90mmHg with dilators. The clamp was then slowly released and further haemostasis secured. Arterial monitoring revealed identical wave-forms in the femoral and radial lines. The chest was closed in layers using two intercostals drains and bupivacaine intercostal blocks.

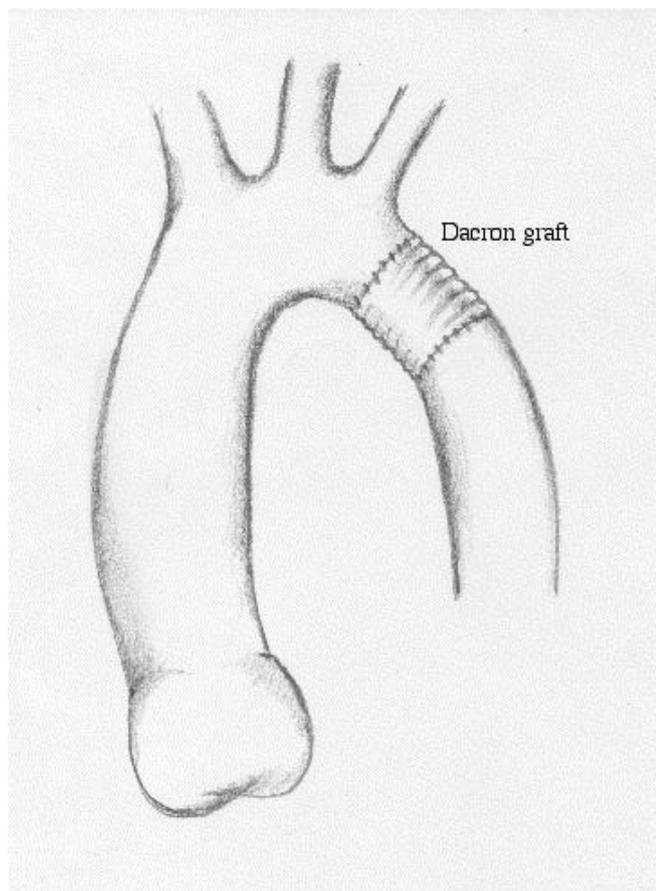


Figure 4b. Dacron interposition graft.

The patient was nursed on intensive care with strict control of blood pressure at under 90mmHg systolic. She was awakened from anaesthesia 4 hours later and was found to be neurologically intact. She required multiple intravenous medications, in order to control hypertension. She was ambulating one week post-operatively and remained in hospital for three weeks, receiving physiotherapy. Over the next month she complained of weakness in her thigh muscles, rendering her unable to climb stairs unaided, and a burning sensation in the skin of her thighs. She was reviewed by a neurologist and underwent two magnetic resonance images of her spine at

three weeks and six weeks post-operatively, both of which were normal. She went on to make a full recovery by eight weeks. No firm diagnosis was made to explain her symptoms.

Discussion

Traumatic aortic rupture is often fatal¹, being the second most frequent cause of death from blunt trauma, after head injury, and accounting for 18% of deaths from motor vehicle accidents.² Eighty five percent of victims of this injury die before reaching hospital³ and half of those reaching hospital will die within 24 hours.² It is important to consider the possibility of aortic rupture in survivors of automobile crashes. This case highlights the importance of a safety belt and airbags. The paucity of symptoms may lead to a missed diagnosis, a minority of patients presenting with hoarse voice, upper chest or back pain.⁴ The clinical picture may be clouded because of poly-trauma.⁵

Mechanism of rupture

The injury is caused by high-speed impacts with rapid deceleration, such as motor vehicle accidents, plane crashes and falls from a great height. The descending aorta distal to the subclavian is fixed to the vertebral column in the posterior mediastinum, whereas the arch and heart are free to move forward on impact.⁶ The differential rates of deceleration result in a shearing force at the junction of the arch and descending aorta, with disruption and haemorrhage. Blood leakage may be temporarily contained by adventitia and mediastinal structures⁷ but this unstable situation results in expansion and rupture over time.⁸ The few patients who survive this acute phase may later develop distal embolisation, compression of adjacent structures such as the bronchus or oesophagus, or fistula formation into these structures with massive blood loss.^{9,10}

Treatment and results

Because of early mortality as well as late fatal complications, immediate surgical repair with placement of an interposition graft is the standard treatment for traumatic aortic rupture. However, certain particular scenarios may favour delayed surgery. A conservative approach may be indicated in the absence of haemothorax in a patient who is stable but suffering from other injuries or sepsis.¹¹ Severe neurological deficit may also favour delayed surgery.¹² Anti-hypertensive treatment including β -blockers is the mainstay of the conservative approach.^{13,14} Over the past two decades experience with intraluminal stent-grafting of abdominal aortic aneurysms has increased^{15,16} and more recently the same principles

have been applied to traumatic rupture of the thoracic aorta, in patients in whom surgery has been delayed.^{3,17,18} In experienced hands stent-grafting is safe but single centre series are small.³ Commonly an inflammatory process “post-implantation syndrome” occurs in the early phase after stent-grafting. Occlusion of the left subclavian may also occur.^{5,16}

Operative mortality exceeds 21%, the risk of paraplegia is 19% with simple aortic cross-clamping and 11% with passive shunting from the left ventricular apex to the descending aorta.¹⁹ Active distal perfusion on pump requires full heparinisation and has been reported to aggravate neurological injuries and increase mortality.²⁰ The strategy for individual patients will necessarily depend on their condition and associated injuries. In a selected series of stable patients undergoing stent-grafting, mortality was 8.5% and the paraplegia rate was 3.6%.²¹ With stents limited to the circumscribed pseudo-aneurysm segment the risk of paraplegia is lower as spinal blood supply is rarely involved by this segment.^{22,23} The vast majority of ruptures are close to the subclavian origin, making stent-grafting technically challenging.²⁴ Other limitations of stent-grafting include size (<40mm diameter), vascular access (18F to 24F delivery system), and the fact that the prostheses are custom made after appropriate measurements are obtained by imaging, necessarily incurring delay.³ Moreover, long-term durability of stent-grafting remains a cause for concern making this technique more suitable for elderly patients or for those with multiple co-morbidities rendering surgery more risky.¹⁶

Traumatic rupture in Malta

The author was involved in one previous case where the diagnosis of aortic rupture was missed until the day after the motor vehicle accident, when the patient suddenly collapsed with massive intra-thoracic haemorrhage. Resuscitation was followed by referral to our team for emergency repair of the aortic rupture but this young male patient died a week later from multi-organ failure, demonstrating the importance of early diagnosis. To our knowledge the present case represents the first successful outcome of traumatic rupture of the aorta in Malta.

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