Case report - Vascular thoracic

Traumatic transection of the innominate artery

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Abstract

A case of transection of the origin of the innominate artery with an associated head injury following blunt thoracic injury is presented. The patient had been the unrestrained driver in a road traffic accident. Investigation demonstrated embolic damage to the brain parenchyma. Early surgical repair employing cardiopulmonary bypass and hypothermic circulatory arrest was successfully performed without extension of the neurological injury.

Keywords: Trauma; Innominate artery; Cardiopulmonary bypass; Hypothermic circulatory arrest

1. Introduction

Traumatic injury to the innominate artery is a rare occurrence. The majority of these injuries are caused by penetrating trauma. However, blunt trauma is also a significant cause with mortality rates in patients who survive to hospital admission in the range of 10–25% [1]. When associated neurological injury is present surgery is often deferred. We report a case of traumatic transection of the innominate artery following a road traffic accident (RTA) with an associated neurological injury in which early repair was successfully carried out.

2. Case report

A 25-year-old woman presented to a regional hospital following an RTA. She had been the unrestrained driver in a single vehicle head on collision. She was ejected from the car and had a brief period of loss of consciousness. At arrival to the hospital she was conscious but confused with no gross neurological deficit. Chest X-ray revealed a widened mediastinum, bilateral pneumothoraces with surgical emphysema and multiple bilateral rib fractures with bilateral flail segments. There was an extensive laceration of the right forearm and facial lacerations. She was resuscitated, ventilated and had thoracostomy tubes inserted bilaterally with drainage of about 200–300 ml of blood from each side. Great vessel injury was suspected and a CT of the thorax, abdomen and head was performed. This revealed a compression fracture of the 12th thoracic vertebra and right scapula fracture as well as the multiple rib fractures with lung contusions. There was an intimal flap at the origin of the innominate artery with surrounding haematoma indicating a false aneurysm (Fig. 1). CT of the brain revealed small defects in both cerebellar hemispheres and occipital lobes suggesting multiple emboli to the posterior cerebral circulation. There was no evidence of an acute brain haemorrhage. Following transfer she remained in a stable condition and underwent an arch aortogram, which demonstrated an intact ascending and descending aorta with complete transection of the innominate artery at its origin (Fig. 2).

Emergency surgical exploration through a midline sternotomy was performed and the radiological findings were confirmed. There was extensive haematoma of the ascending aorta, which extended to the proximal innominate artery as well as the arch of the aorta. Examination of the vessels did not favour placement of vascular clamps. Hence it was decided that the repair be carried out using hypothermic circulatory arrest (HCA). This was achieved by cannulating the left femoral artery and the right atrium to commence cardiopulmonary bypass with full heparinisation and induction of hypothermia. HCA was performed at...
a nasopharyngeal temperature of 18 °C. Cold blood cardioplegia was delivered to achieve diastolic arrest. The vessels were mobilized and the pseudoaneurysm opened. There was only adventitial layers preventing impending rupture of the vessel. HCA period of 14 min was required to dissect the injured innominate trunk and site a 10-mm diameter tube graft (Uni-Graft K DV B, Braun Surgical GmbH) using continuous 4/0 prolene to construct the anastomoses. The patient tolerated the procedure well and postoperatively she was stable.

She required orthopaedic as well plastic surgical procedures for her concomitant injuries and needed 10 days of ventilatory support. She was discharged from the intensive care unit on the 12th post-operative day and made a good recovery. A follow-up CT brain performed on the fifth day postoperatively revealed areas of matured infarcts in the left occipital lobe and cerebellum. The infarcts had the appearance of multiple emboli with minimal haemorrhagic changes. The suspected source of the emboli was the transected site of the innominate artery at the time of injury. She was discharged home after 5 weeks. At 5 months she was well and had returned to normal activities except for driving. She did have an ongoing mild visual impairment, which prevented her from being able to drive confidently.

3. Discussion

The innominate artery is the second most common site of blunt injury to the aorta. The lesion is usually found at the origin of the vessel from the aortic arch [2]. Avulsions or transection injuries at the origin of the innominate artery are immediately life threatening and most patients die before reaching the hospital [3]. The postulated mechanism of injury is an anterioposterior compression of the mediastinum between the sternum and the vertebrae that displaces the heart posteriorly and to the left. This increases the curvature of the arch and causes tension on the outlet vessels. Additionally, hyperextension of the cervical spine and left lateral head rotation places traction on the right carotid, which in turn transmits further tension to the innominate artery. As the heart moves to the left a proximal avulsion of the innominate artery results [2]. Diagnostic clues to this type of injury include the type of trauma, i.e. deceleration injury, symptoms, signs and radiological findings. Angiography has been recommended as the standard investigation to evaluate the presence and the extent of great vessel injuries following blunt thoracic trauma [4]. Angiography is probably not mandatory but can add to the information from CT scanning and enable optimum decision making regarding surgical intervention [5]. Cardiopulmonary bypass has been used in the surgical repair of these injuries although usually in the absence of concomitant neurological injury with its associated risk of cerebral bleeding [2]. Although there would be an increase in soft tissue bleeding with full heparinization, the risks of new intraabdominal or orthopaedic bleeding does not manifest itself especially if such associated problems are diagnosed and dealt with first [6]. The repair of these unusual types of injury may not be possible with partial vascular clamps especially when the innominate artery and left common carotid artery are involved. Some means of brain protection would be required and repair using hypothermic circulatory arrest in this situation has been described [7]. Although our patient had no obvious signs of neurological deficit prior to ventilation, the CT of the brain demonstrated otherwise but with no evidence of bleeding. Published data show that preoperative central nervous system deficits are associated with high mortality [1] and
other authors have even delayed surgery in selected patients in the presence of cerebral injury [8]. Surgery in this case was advocated immediately to prevent fatal rupture as demonstrated by the artogram. Repair of blunt injuries to the innominate artery is a challenge uncommonly faced in the practice of most surgeons. A rapid diagnosis should be made based on detailed description of the mechanism of injury and confirmed by imaging techniques. Timing of surgical repair is critical to a successful outcome. While associated neurological injury is often a reason for deferring surgery, this is not always necessary and early intervention, particularly in those without evidence of an acute cerebral bleed may be advantageous.

References


Appendix A. ICVTS on-line discussion

Author: Dr. Hitoshi Hirose, Cleveland Clinical Foundation, Department of Thoracic and Cardiovascular Surgery, 2300 Overlook Road #312, Cleveland, OH 44106, USA

Date: 29-Jul-2003

Message: An interesting paper about traumatic transection of the innominate artery. Previous review of the literature shows most of the innominate artery injury occurs in the proximal portion of the innominate artery [1]. I agree with the authors that the patient with proximal innominate artery transection with an evidence of cerebral ischemia should undergo bypass surgery under deep hypothermic circulatory arrest. The patients with ongoing cerebral ischemia carry higher mortality as the authors described [2]. Preoperative study of the brain to rule out intracranial bleeding is important because the surgical repair of the innominate artery require systemic administration of heparin. A successful surgical repair of innominate artery injury without extension of the brain injury.

References


Response

Author: Mr. Devendren Veerasingam, Consultant Cardiothoracic Surgeon, National Cardiothoracic Surgery Centre, Mater Misericordiae Hospital, Eccles St, Dublin, Ireland.

Date: 21-Aug-2003

Message: This group of patients is uncommon and often present with multiple trauma. Fortunately, we managed to rule out any form of active bleeding prior to surgery. Pooled data in forums such as these are of benefit for future management of such cases.