Cardiac surgery take-away kit

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Background: Trauma to the heart is usually rapidly fatal, but survival can be improved with timely and appropriate surgical management. However, certain injuries require specialist cardiothoracic surgical intervention.

Methods: Three patients with coronary artery lacerations treated by cardiac surgeons at remote hospitals are presented. The recent literature, the current treatment options available and suggestions on techniques to improve survival are reviewed.

Conclusions: Laceration of the coronary arteries is difficult to manage, especially in the absence of specialty equipment. Appropriate protocols should be established to provide this service in order to optimise the management of patients with complicated trauma. A cardiac surgical take-away kit could facilitate the management of these difficult patients in a setting remote from the cardiac operating room.

Trauma to the heart is often rapidly fatal.¹ However, long-term results can be excellent if timely and appropriate surgical management is undertaken. Trauma surgeons are skilled in the management of myocardial lacerations and contusions. However, cardiothoracic surgeons (CTSs), special equipment and other facilities may be necessary for the management of more complicated cardiac injuries involving the valves and coronary arteries. As rapid patient transfer to specialist cardiothoracic centres is difficult within the United Kingdom, the emergency provision of CTS services needs to be arranged and organised.

We present three cases in which coronary artery lacerations were treated by cardiac surgeons at remote hospitals. A review of the literature, current treatment options and suggestions on techniques to improve survival are also presented.

CASE 1

A 19-year-old male was stabbed in the left chest medial to the nipple. Emergency room thoracotomy (ERT) was performed to relieve cardiac tamponade. The proximal left anterior descending coronary artery (LAD) had been transected. A CTS from another centre was called in. Initial LAD ligation was attempted but was not tolerated. A coronary artery surgical shunt and reversed saphenous vein were used to perform coronary artery bypass grafting (CABG) without the use of cardiopulmonary bypass (CPB). The patient had a large anterior myocardial infarction and developed clot within the left ventricle. He is alive, without symptoms, 4 years later.

CASE 2

A 27-year-old male was admitted with two stab wounds just above the suprasternal notch in the midline and 2 cm above the left nipple. A left intercostal tube was inserted and drained a litre of blood. The CTS team was contacted, the patient was anaesthetised and a median sternotomy was performed. A laceration to the anterior right ventricle that transected the mid LAD was found. The front wall of the left ventricle was pale and akinetic. The right ventricle was repaired with interrupted polypropylene sutures and the LAD ends were ligated. The patient was transferred with chest open to the regional CTS centre. An intra-aortic balloon pump (IABP) was inserted and the patient was placed on CPB. A reversed saphenous vein was used to perform CABG to the distal transected LAD.

Ventricular function improved immediately and no inotropic support was required. The patient continues to do well with unlimited exercise tolerance after 2 years.

CASE 3

A 21-year-old male was stabbed in the left fourth intercostal space just beneath the nipple. He was agitated, confused, struggling to breathe and in shock. He arrested repeatedly despite resuscitation. Open cardiac massage was attempted through a left anterior thoracotomy. The CTS team arrived from another hospital. Access to the heart was found to be inadequate (the pericardium had not been opened despite the presence of a bleeding laceration). The sternum was cut and the incision extended across the midline. The pericardium was opened and clots were evacuated. There was a 2-cm transverse laceration to the right ventricle adjacent to the interventricular septum and the mid LAD was transected. The right ventricle was repaired with 3–0 polypropylene sutures buttressed with autologous pericardium and the two ends of the LAD were ligated. There was initial cardiac recovery, but refractory ventricular fibrillation developed and the patient died within 3 h of presentation.

DISCUSSION

These three young men represent the typical victim of chest stabbings. They all presented to trauma centres without CTS services. However, they were managed differently, illustrating a variety of considerations in the management of patients with major cardiac trauma.

Who should treat?

The CTS is rarely a member of the trauma team and less than half of the trauma centres in the UK possess on-site CTS services. Lacerations to the atrial and ventricular walls and the aorta are manageable by most trauma surgeons. The ERT is a life-saving procedure, but attending surgeons need to know their limitations and recognise the need for and type of further assistance. If injuries to the cardiac valves occur, CPB and other specialty equipment are needed and the patient would be better served by resuscitation and transfer. Coronary artery injuries

Abbreviations: CABG, coronary artery bypass grafting; CPB, cardiopulmonary bypass; CTS, cardiothoracic surgeon; ERT, emergency room thoracotomy; IABP, intra-aortic balloon pump; LAD, left anterior descending coronary artery; OPCAB, off-pump coronary artery bypass grafting

are difficult to manage. In some cases, the personnel may possess the required ability but lack appropriate equipment, and so patient transfer may still be necessary.

In the three cases discussed, the CTS did not form part of the initial management team. The initial resuscitations were prompt and efficient, but definitive management would have been better had the CTS been available earlier.

Should the surgeon or the patient travel?

This is a difficult decision and the individual case should be discussed between the transferring and receiving physicians.² If the patient has haemodynamic instability or is likely to deteriorate during transfer, then the surgeon should travel to the patient. The principle is the same for movement within the hospital (such as to the CT scanner). Transfer vehicles seldom have adequate space, equipment or personnel for life-saving procedures (such as tracheostomy, thoracostomy, thoracotomy, etc) to be performed safely. Even endotracheal intubation would be difficult inside a transfer vehicle (personal experience). In the cases described the surgeon travelled to the patient and was able to commence management.

The take-away kit

In all cases suitable equipment was not available for the CTS and had to be sent for. This suggested the basis for a take-away kit (table 1). Most cardiac procedures are carried out via a median sternotomy and many surgeons prefer this access. Often a Gigli saw is available for sternotomy, but as it can be difficult to get it around the sternum, an electric saw is preferred. The hemi-clam shell incision is preferred by trauma surgeons and has the advantages that it is easily performed and can be extended across the midline to provide access to both pleural cavities and the mediastinum. Thoracic retractors are usually available and are essential for adequate exposure once the incision is made. Appropriate use of bone wax can significantly improve visibility. Several useful adjuncts for control of bleeding include the sutures listed, fine needle holders, snares, surgical sealant and biological glue. Sutures often pull through the heart muscle and Teflon pledgets are helpful. The patient's own pericardium can also be used for buttressing.

Intracoronary shunts are routinely used during CABG, especially when the CPB pump is not used (called "off-pump coronary artery bypass grafting" or "OPCAB"). Shunts are flexible and blood flow down the centre maintains distal myocardial perfusion while the anastomosis is performed. They are difficult to obtain in emergencies but can be life-saving.³ In case 1, an intracoronary shunt was used to provide distal coronary flow while the CABG was performed. The transected LAD was difficult to repair and the anastomosis was performed distally, then the shunt was removed and the LAD ends were

ligated. Special retractors are used to stabilise the heart during OPCAB but are not essential.

Other tools

Routine cardiac surgery is often performed with the aid of a CPB pump which provides circulatory support and facilitates a bloodless operative field.⁴⁻⁶ The pump is cumbersome, but mobile pumps are available for emergencies⁴ and Mattox used a portable CPB machine.⁵ The services of a perfusionist are required to run a CPB pump. However, in the patient with multiple traumas, heparin administration may not be advisable if there is a risk of bleeding from other sites; heparin-bonded CPB circuits may reduce the need for anticoagulation but present other risks. In addition, most CTSs have experience with "off pump" techniques. Although CPB is a useful adjunct, it is neither essential nor practical to have a mobile pump and perfusionist available to go to another hospital.

The IABP can also be used to provide circulatory support and can increase blood flow in an acutely obstructed coronary artery.⁷ IABPs are available in most centres. Interhospital patient transfer with an IABP is difficult but manageable (personal experience). However, aortic incompetence is an absolute contraindication for IABP. In case 2, an IABP was inserted after transfer to the CTS centre.

Patients who suffer cardiac injuries are more likely to die than to survive to hospital. Some of these patients require specialist cardiothoracic surgical intervention. Lacerations of the coronary arteries are difficult to manage, especially in the absence of specialty equipment. Demetriades *et al*¹ presented the largest series of patients with cardiac injuries, which included 407 patients who died before hospital admission and 125 who were treated in hospital. Espada *et al*⁸ reported the largest series of nine patients with coronary artery lacerations.

Ligation of the artery was performed in eight of the nine patients in Espada's series, all of whom survived. This treatment results in ischaemia and infarction of the muscle supplied by the relevant artery but may be tolerated with minimal inotropic support.

Coronary artery injuries have also recently been reported after blunt chest trauma,⁸ although arterial dissection rather than transection seems to be more common. The basic principles are the same in making the initial diagnosis and instituting appropriate specialist management.

CONCLUSIONS

Multiple trauma patients would benefit from a quick transfer to hospitals that provide the whole range of trauma services. Unfortunately, very few centres provide a complete service.

Emergency department staff effectively provide the initial management of the patient with thoracic trauma. However, early recognition of more serious injuries calls for specialist physicians and special equipment. Appropriate protocols should be established to provide this service in order to optimise the management of patients with complicated trauma. The cardiac surgical take-away kit could facilitate the management of these difficult patients in a setting remote from the cardiac operating room.

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Informed consent was obtained for publication of peoples' details in this report.

Table 1 A suggested take-away pack that will assist the cardiothoracic surgeon to perform better away from the specialty cardiothoracic surgical centre

Sternal saw (preferably battery-powered with sterilisable battery)
Chest retractor
Teflon pledgets
4/0 polypropylene (on a big needle), 5/0, 6/0 and 7/0 polypropylene
Fine needle holder (eg, Castroviejo, Ryder)
Intracoronary shunts of various sizes (1.5–2.5 mm)
Epicardial pacing wires, accompanying leads and pacemaker box
Sternal wires, accompanying needle holder and wire cutter
Rummel tourniquet and snares
Bone wax
Surgicel
Bioglue

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IMAGES IN EMERGENCY MEDICINE

Mesoaortic compression of left renal vein revealed by multidetector computed tomography: nutcracker syndrome

Wan-Ju Yang, Yu-Peng Liu, Fei-Shih Yang

A 63-year-old woman presented with acute sharp left flank pain of 2 days duration and came to our emergency unit for help. Initial investigations, including repeat cultures of urine and urine cytology, showed microscopic haematuria but were otherwise normal. Ultrasound of the urinary tract revealed mild right pelviectasis. The patient continued to have non-colicky left flank and lower abdominal pain which was aggravated by a change in position. Past medical and family history was non-contributory. Multidetector computed tomography (MDCT) showed a dilated left renal vein with abrupt narrowing between the aorta and superior mesenteric artery (fig 1). After admission, Doppler ultrasound examination of the kidneys demonstrated an enlargement of the left renal vein proximal to the aorta–mesenteric junction. Nutcracker syndrome was diagnosed. Nutcracker syndrome is a rare but important clinical condition that should be considered in the patients with

microscopic haematuria, left flank pain and mesoaortic compression of left renal vein revealed by MDCT.¹

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Figure 1 (A) Multidetector computed tomography showing a dilated left renal vein (arrow) with abrupt narrowing between the aorta and superior mesenteric artery. (B) Normal left renal vein without narrowing between the aorta and superior mesenteric artery in another patient.