Successful repair of a penetrating wound of the thoracic aorta

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Ramanathan, T., Somasundaram, K., and Yong, N. K. (1975). Thorax, 30, 348–351. Successful repair of a penetrating wound of the thoracic aorta. Penetrating wounds of the aorta are not necessarily fatal. A successfully managed patient with a stab wound of the ascending aorta is reported, and some problems of management associated with such injuries are discussed.

Successful repair of penetrating injuries of the thoracic aorta is rare because of the massive blood loss and the inability to cross clamp the aorta safely and totally. From 1922 (Dshanelidze, 1926) to 1973, 44 successfully treated cases have been reported. This paper reports another, reviews the literature, and discusses some problems of management associated with such injuries raised by previous reports.

CASE REPORT

A 23-year-old Malay man was stabbed in the right upper chest on 29 January 1974. He was admitted to hospital within half an hour of the trauma.

Examination revealed the patient to be centrally cyanosed, restless, and sweaty. The pulse rate was 150/min and the blood pressure was 40 mmHg systolic. Both carotids and radials were palpable. The heart was in sinus rhythm but the heart sounds were distant. Auscultation of the chest revealed markedly diminished air entry over the right chest which was dull to percussion. A 1.75 cm stab wound was found in the second right interspace 5.0 cm to the right of the sternal edge.

A provisional diagnosis of right haemothorax was made. A supine chest radiograph showed opacification of the right lung field and some widening of the superior mediastinum (Figure).

An immediate right anterolateral thoracotomy revealed one litre of blood in the pleural cavity, laceration of the superior mediastinal pleura, and the pericardial cavity tense with blood. On opening the pericardium the intrapericardial portion of the ascending aorta was seen to be lacerated on its anterolateral aspect. Haemostasis was achieved by a side clamp and the blood pressure

was restored to a normal level. The laceration was sutured with a double row of over and over atraumatic 0000 silk sutures.

The postoperative course was uneventful and the patient was discharged two weeks after operation perfectly well.

DISCUSSION

Our review of the literature revealed 44 patients successfully treated for penetrating wounds of the thoracic aorta. Detailed information is available in 24 of these cases (Table). In another 32 cases injury to the aorta was associated with a fistula between the aorta and cardiac chambers, aorta and pulmonary arteries or aorta and systemic veins.

Parmley, Mattingly, and Manion (1958), in 45 necropsies for penetrating wounds of the heart and aorta, found that 12% of patients survived more than one hour. The few patients who reached hospital alive were either transported rapidly before exsanguination or survived because bleeding from small wounds had ceased.

Patients with penetrating injury of the aorta arriving in hospital alive are usually in severe shock. Their immediate management is by rapid transfusion with O negative blood and the maintenance of an adequate airway. Large amounts of O negative and type specific blood must be available at short notice. Resuscitation must be prompt and effective. The availability of large amounts of blood and experience in resuscitating severely shocked patients partly accounted for the high salvage rate in Vietnam casualties (Billy, Amato, and Rich, 1971).

FIGURE Preoperative chest radiograph showing widening of mediastinum and opacification of the right hemithorax.

The diagnosis of penetrating wounds of the aorta is suspected by the trajectory of the missile or the direction of entry of the stabbing instrument or when bleeding is massive or continuous. The diagnosis is confirmed at thoracotomy.

Injury to the intrapericardial portion of the aorta usually results in tamponade, which may be relieved by pericardiocentesis. Associated haemothorax with or without pneumothorax necessitates the evacuation of blood and air from the pleural space. If sufficient blood is not available immediately, autotransfusion presents a possible solution to the problem of massive blood loss (Symbas and Sehdeva, 1970). Bleeding into the pericardium is sometimes compatible with survival (Diveley, Daniel, and Scott, 1961) as in our patient.

If bleeding is massive, thoracotomy is rapidly performed and haemostasis is achieved by digital compression. When bleeding is not massive or if the laceration is temporarily sealed by clot an aortogram can be performed. The patient must have large-bore polythene cannulae in the veins with facilities for rapid transfusion and transport

to theatre for emergency thoracotomy should the patient collapse after the aortogram (Conn *et al.*, 1971).

A stab wound of the side of the aorta can usually be repaired after partial tangential occlusion of the aorta. Through and through stab or bullet wounds frequently require proximal and distal cross-clamping of the aorta. Cross-clamping of the descending thoracic aorta is said to be safe if it lasts less than 20–30 minutes (Eiseman and Summers, 1955; Adams and van Geertruyden, 1956) but paraplegia has occurred after shorter periods of cross-clamping of the aorta (Symbas and Sehdeva, 1970). If the aorta has to be cross-clamped, the use of a local bypass may afford protection to the spinal cord. The technique of cardiopulmonary bypass requires total body heparinization. Systemic heparinization may result in uncontrollable mediastinal haemorrhage after an otherwise successful operative repair and adequate neutralization of heparin (DeMeester, Cameron, and Gott, 1973). Alternatively, through and through laceration of the ascending aorta

T A B L E
PENETRATING WOUNDS OF THE THORACIC AORTA SUCCESSFULLY REPAIRED 1922-73

Authors	Date	Cause of Injury	Location of Aortic Injury	Type of Injury	Type of Repair	Interval between Injury and Definitive Treatment
Dshanelidze	1926	Stab wound	Intrapericardial thoracic	1 cm Laceration	Suture	Not stated
Blalock	1934	Stab wound	Intrapericardial thoracic	Ice pick injury	Suture	Soon after admission
Elkin	1941	Stab wound	Intrapericardial thoracic	Ice pick injury	Suture	—
Elkin	1944	Stab wound	Intrapericardial thoracic	Knife wound	Suture	—
Beattie and Greer	1952	Stab wound	Intrapericardial thoracic	14 mm Laceration	Suture	48 hours
Keeley	1958	Gunshot wound	Descending thoracic	Not known	Suture	Not stated
Kleinert	1958	Gunshot wound	Descending thoracic	1.5 cm Laceration	Suture and patch	Not stated
Perkins and Elchos	1958	Stab wound	Extrapericardial ascending thoracic	2 cm Laceration	Suture	2 hours
Baret <i>et al.</i>	1958	Stab wound	Descending thoracic	1.5 cm Laceration	Suture	29 hours
McCann	1958	Ice pick	Extrapericardial ascending thoracic	1 cm Laceration	Suture	Immediately
Linberg	1959	Gunshot wound	Descending thoracic	4.5 mm diam.	Suture	2 hours
Beall	1960	Gunshot wound	Descending thoracic	Laceration	Suture	Immediate
Diveley <i>et al.</i>	1961	Missile—wire	Extrapericardial thoracic	3-4 mm Hole	Suture	36-48 hours
Beall <i>et al.</i>	1962	Stab wound	Intrapericardial thoracic	Not stated	Not stated	Immediate
Beall <i>et al.</i>	1962	Stab wound	Intrapericardial thoracic	Not stated	Not stated	Immediate
Stelzner and Horatz	1963	Gunshot wound	Extrapericardial ascending	Small bullet	Suture	30 minutes
Overbeck and Gruenagel	1968	Missile—metal splinter	Intrapericardial thoracic	3 mm Laceration	Suture	3 hours
Symbas and Sehdeva	1970	Stab wound	Descending aorta	Laceration	Suture	Not stated
Symbas and Sehdeva	1970	Stab wound	Intrapericardial thoracic	Laceration	Suture	Not stated
Conn <i>et al.</i>	1971	Gunshot wound	Arch of aorta—between L. common carotid and L. subclavian	Perforation	Suture	5-6 hours
Fromm <i>et al.</i>	1970	Gunshot wound	Descending aorta	Through and through perforation	Suture	Not stated
Fromm <i>et al.</i>	1970	Gunshot wound	Descending aorta	Through and through perforation	Suture	Minutes after admission
Fromm <i>et al.</i>	1970	Gunshot wound	Descending aorta	Through and through perforation	Suture	4 hours after injury
DeMeester <i>et al.</i>	1973	Gunshot wound	Aortic arch	Through and through and avulsion of origin of L. common carotid	Suture	Immediately
Present study	1974	Stab wound	Intrapericardial aorta	1 cm Laceration	Suture	30 minutes

can be repaired under hypothermia and inflow occlusion. The ascending aorta is opened and the laceration of the posterior wall sutured. The aortotomy is then controlled by a side clamp and the cavae are released (Diveley *et al.*, 1961). DeMeester *et al.* (1973) used a heparinized polyvinyl shunt between the ascending aorta and the left femoral artery in the operative treatment of a through and through gunshot wound of the arch of the aorta with avulsion of the origin of the left common carotid artery. Kirsh *et al.* (1970) used a non-heparinized shunt in patients with acute traumatic rupture of the aorta. They state that total heparinization is not needed and clotting does not occur in the shunt once flow has started in it. The use of heparinized shunts is probably safer in very sick patients with low blood pressure and an increased risk of cardiac arrest during surgery.

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