

Successful Surgical Management of Through-and-Through Stab Wound of the Aortic Arch *

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PENETRATING wounds of the aorta have long been considered fatal injuries. Since the first successful repair of such a wound in 1922,⁴ sporadic reports of penetrating wounds of the aorta with long-term survival have appeared. A review of these reports in 1960 revealed at least 14 successful cases, and an additional seven patients surviving penetrating aortic injuries were reported.¹ Such wounds are not necessarily fatal, and with the rapid institution of resuscitative measures many of these patients can be saved.

In this day of rapid advances in cardiovascular surgical technics, successfully managed cases of penetrating wounds of the aorta are being reported with increasing frequency (Table 1). In many of these cases not only was hemorrhage controlled, but complicated fistulas also were repaired. An unusual case of suprasternal stab wound involving the left innominate vein and penetrating through-and-through the aortic arch was recently encountered at the Jefferson Davis Hospital, a city-county hospital for the indigent. This patient presented several problems in management, and the successful outcome appears to be worthy of reporting.

Case Report

J. E. B., a 23-year-old Negro man, was admitted to the Jefferson Davis Hospital on November 25, 1960, after being stabbed several times with a knife one hour previously. The patient was

semistuporous and smelled strongly of alcohol. His shirt was bloodstained anteriorly and there was fresh clotted blood around a stab wound one inch above the suprasternal notch. Superficial stab wounds were present in the left deltoid region and in the area of the left hip. Admission blood pressure was 130/70 mm. Hg. The pulse was 88 and respirations were 18. The chest was clear, heart sounds were of normal intensity and all peripheral pulses were present and equal. Venous pressure was 80 mm. H₂O. X-ray examination of the chest was suggestive of mediastinal widening (Fig. 1a).

The patient was placed in the receiving ward for observation. His blood pressure gradually declined until it reached 90/60 mm. Hg four hours after admission. The pulse rate increased to 120 and respirations to 32. A marked continuous thrill and bruit were detected over the anterior chest, most pronounced in the second left intercostal space in the parasternal region. Venous pressure increased to 210 mm. H₂O. Repeat roentgenograms of the chest revealed definite mediastinal widening, most marked in the superior portion (Fig. 1b).

Under general endotracheal anesthesia the mediastinum was explored through a median sternotomy. A large mediastinal hematoma was present as well as minimal hemopericardium. Further exploration revealed that the knife had penetrated the left innominate vein, entered the arch of the aorta proximal to the origin of the left subclavian artery and had exited posteriorly and inferiorly into the pericardial sac (Fig. 2). There was no discernible cardiac wound.

Additional exposure was obtained by a left supraclavicular extension of the incision. Umbilical tapes were placed around the left innominate vein proximal and distal to the openings, and bleeding was controlled by pulling up on these tapes. As exploration proceeded into the region of the aortic arch, profuse hemorrhage occurred from the superior aortic wound. This was controlled by direct finger pressure and the wound was repaired by passing a continuous suture of 4-0 arterial silk beneath the finger. At this point a gush of blood occurred from the inferior aortic

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TABLE 1. Recent Reports of Penetrating Wounds of the Aorta Successfully Repaired

Authors	Date	Cause of Injury	Location of Aortic Injury
McCann ⁸	1958	Ice pick	Ascending thoracic
Smyth, <i>et al.</i> ¹²	1959	Stab wound	Ascending thoracic to right ventricle
Linberg ⁵	1959	Gunshot wound	Descending thoracic
Mavor and Anderson ⁷	1960	Gunshot wound	Abdominal to interior vena cava
Manlove, <i>et al.</i> ⁶	1960	Gunshot wound	Abdominal
Nissen ¹⁰	1960	Gunshot wound	Descending thoracic
Swanepoel, <i>et al.</i> ¹³	1961	Stab wound	Ascending thoracic to right atrium
Diveley, <i>et al.</i> ³	1961	Stab wound	Pulmonary artery to ascending thoracic to right atrium
Diveley, <i>et al.</i> ³	1961	Missile	Ascending thoracic
Diveley, <i>et al.</i> ³	1961	Stab wound	Arch to pulmonary artery

wound. Bleeding from this wound also was controlled by finger pressure while the aortic arch was rotated forward and to the right, exposing the wound. This was repaired by passing a continuous suture of 4-0 arterial silk beneath the finger. Both openings in the left innominate vein were repaired with continuous sutures of 5-0 arterial silk, and the wound was closed with underwater-seal drainage. Blood loss throughout the procedure was easily replaced through a large bore polyethylene catheter in the left saphenous vein. Total blood replacement was 5,000 ml.

The patient's subsequent course was uneventful and he was discharged from the hospital ten days following operation. Roentgenograms of the chest revealed return of the mediastinum to normal (Fig. 1c). He is being followed as an outpatient, has returned to work, and is asymptomatic.

Discussion

Twenty-three patients with penetrating wounds of the aorta were reported from this institution in 1960.¹ Ten (43.5%) of these survived operation and seven (30.5%) were long-term survivors. Subsequently ten additional patients with penetrating aortic injuries have been seen, of which three were long-term survivors. The total experience in this institution is represented diagrammatically in Figure 3. With an aggressive approach approximately one-third of these patients can be salvaged. Many of those who succumb do so from multiple associated injuries rather than

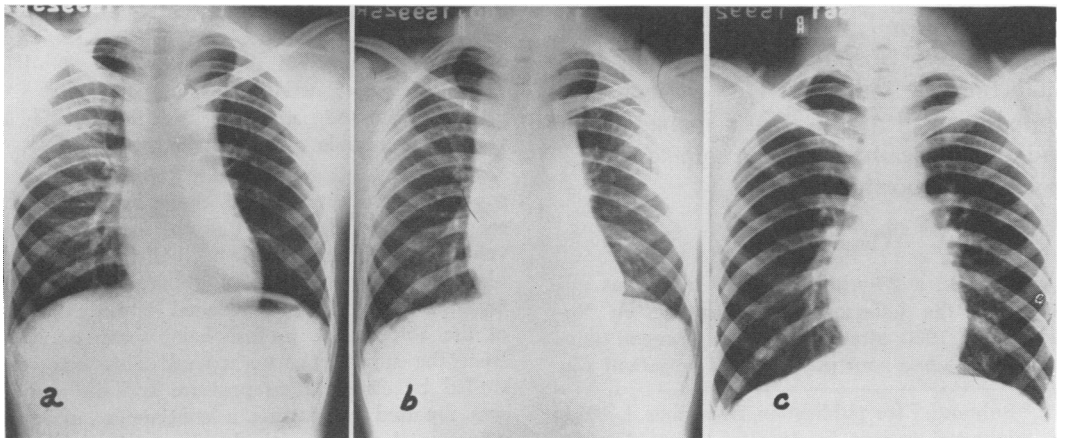


FIG. 1. Roentgenograms of chest (a) on admission suggesting widening of mediastinum, (b) four hours after admission demonstrating progressive widening of mediastinum, and (c) at time of discharge from hospital.

from the aortic wound itself. With such experience, penetrating aortic wounds cannot be considered universally fatal.

In order to salvage a significant number of these patients several factors in their management are exceedingly important. Resuscitation is begun during the initial examination of the patient. Not only must large quantities of whole blood be available, but an adequate route of administration must be assured. This can be accomplished satisfactorily by inserting a large bore polyethylene catheter into an extremity vein. An upper extremity vein should be used if the wound is below the diaphragm, due to the possibility of an associated inferior vena caval injury.

Associated injuries must be managed concomitantly. Pericardial tamponade is treated primarily by pericardicentesis, but thoracotomy is employed without hesitation if there is inadequate response to pericardial aspiration or if tamponade recurs. Sucking wounds of the chest are closed temporarily by rapid suture or vaseline gauze pressure dressings. Intercostal thoracostomy tube drainage is instituted im-

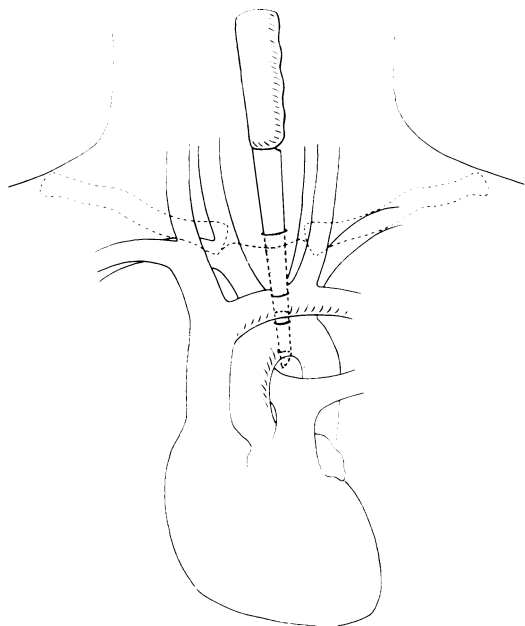


FIG. 2. Diagram showing tract of knife wound through left innominate vein and arch of aorta, exiting from posteroinferior aspect of arch.

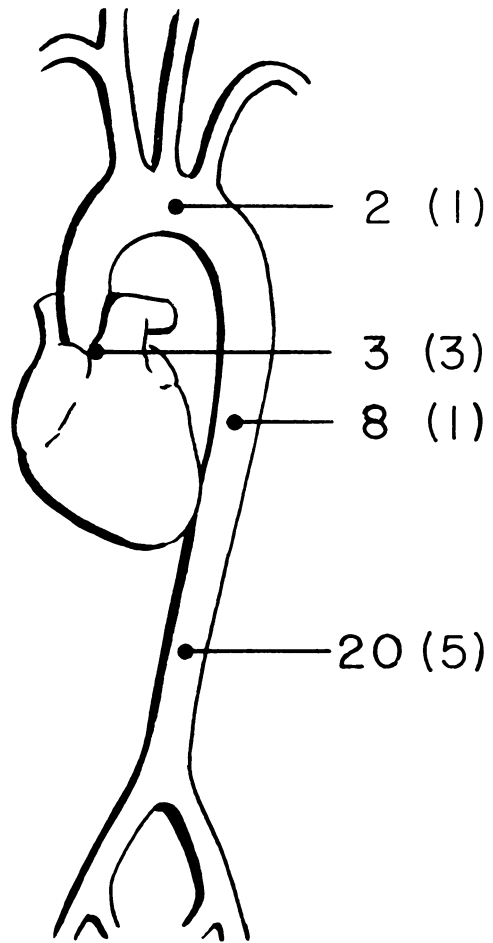


FIG. 3. Location of 33 penetrating wounds of aorta admitted to Jefferson Davis Hospital. Numbers in parenthesis represent patients salvaged.

mediately if significant pneumo- or hemothorax is present.

As soon as an aortic injury is suspected operation does not await resuscitation, but is carried out as an integral part of resuscitation. In the present case hypotension and tachycardia in the presence of a widened upper mediastinum allowed such an injury to be considered. Finding a continuous murmur suggested presence of an associated communication with venous system.

Skin preparation and draping procedures are carried out prior to the induction of anesthesia, and minimal amounts of anesthetic agents are employed. For abdominal injuries a midline incision is routinely used and affords rapid access to all areas of the

peritoneal cavity. Incisions for thoracic injuries vary with the suspected injury and its location. A median sternotomy was employed in the present case and gave excellent access to the great vessels. Should further exposure be required, incision may be extended into an intercostal space on either side of the sternum. Supraclavicular extensions may be used, as in this case.

Control of hemorrhage is of the utmost importance. Primary control of the bleeding point should be with local pressure, either with the finger or with a pack. Then the aorta above and below the injury is isolated and clamped, a partial occluding clamp is applied, or sutures are passed under the finger occluding the wound. Attempts at primary isolation of the aorta above and below the injury are usually met with further massive blood loss and failure. Occasionally, temporarily clamping the lower thoracic aorta is helpful in the management of abdominal aortic injuries, but primary control is with pressure.

Most extracardiac fistulas can be managed concomitantly, as was done in this case. Although successful, delayed repair of fistulas between the aortic arch and innominate vein have been reported,^{9, 11} such a delay predisposed to numerous hemodynamic changes and the possibility of a cardiac failure. Complicated intracardiac fistulas are best managed by a period of delay during which an accurate anatomical diagnosis can be made and then repaired utilizing total cardiopulmonary bypass.²

Finally, blood replacement should proceed throughout the management of the case. Every effort should be made to keep up with blood loss as it occurs. Adequate blood replacement should be completed prior to closing the wound. Otherwise, injuries bleeding may be missed because of hypotension. When the wound is closed and hypotension is overcome by blood replacement, brisk hemorrhage may occur.

Summary

Penetrating wounds of the aorta are not necessarily fatal. Successful cases are being

reported with increasing frequency. A successfully managed patient with a through-and-through stab wound of the aortic arch is reported, and a group of 33 cases with penetrating aortic injuries is reviewed. Ten of these patients were long-term survivors. With a salvage rate of this magnitude in an injury generally considered fatal, every effort should be made to rapidly recognize and adequately treat these injuries.

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