Traumatic Disruptions of the Aorta: Management of 20 Cases

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Abstract

Twenty-two consecutive patients with thoracic aortic disruptions were treated over a three-year period. With the exception of 3 patients who required emergency thoracotomy, aortography was performed on all patients. The disruption was identified just distal to the left subclavian in all cases. Two patients died intraoperatively prior to repair. A Gott shunt was utilized in 5 patients, cardiopulmonary bypass in 1, and the "clamp-and-sew" technique in 14. Paraplegia occurred in 2 patients (14%) of the "clamp-and-sew" group. These patients had aortic cross-clamp times in excess of thirty minutes. Paraplegia did not develop when either cardiopulmonary bypass or a Gott shunt was used. Additionally, multiple tears of the descending aorta, which were not visualized on aortography, were found intraoperatively in 2 of 19 patients (10.5%). One was treated with graft insertion on cardiopulmonary bypass, and the second, with graft insertion of the "clamp-and-sew" technique. The second patient developed paraplegia, attributed to the prolonged clamp time. In conclusion, a shunt procedure would seem to provide better protection of the spinal cord, especially when multiple sites of aortic injury are identified.

Introduction

Traumatic disruption of the aorta is a highly lethal injury. Its frequency of occurrence has increased, paralleling the rise in numbers of high-speed motor vehicle accidents. Approximately 80%
of the victims die at the accident scene owing to extensive aortic injuries and exsanguination. Those patients with confined tears survive long enough to reach medical care. With our current capabilities of rapidly resuscitating and transporting accident victims, we can expect to see patients with more extensive injuries surviving to reach the hospital. This report describes our experience with traumatic disruptions of the aorta and includes 2 patients with multiple thoracic aortic tears.

Patients and Methods

Cooper Hospital/University Medical Center is the Level I Trauma Center for the southern New Jersey region. During the thirty-six month period from January, 1985, through December, 1987, 22 patients admitted through our trauma service were diagnosed as having a disruption of the thoracic aorta. Eleven patients had initially been evaluated at another hospital and subsequently transferred to our institution because of the severity of their injuries. The remaining 11 were brought directly from the accident scene.

Nineteen men and 3 women patients ranged in age from twenty-one to seventy-three years. Twenty were victims of automobile accidents, and 2 were injured riding motorcycles. Twenty-one patients had chest roentgenograms, all of which demonstrated findings suggesting the diagnosis of disrupted thoracic aorta: widened mediastinum, hemothorax, and first-rib or multiple rib fractures. At the time of presentation, 3 patients were in profound shock unresponsive to fluid resuscitation and underwent emergency thoracotomy. Two of these patients died intraoperatively, the third survived to a full recovery. The remaining 19 patients either were stable at the time of presentation or were successfully volume resuscitated and underwent aortography prior to surgery. In all 19, a disruption of the thoracic aorta was
identified at the distal arch; there were no aortic root injuries nor were any proximal aortic lesions noted.

Concomitant injuries to other organ systems were frequently found. Closed head injuries, including cerebral contusion and intracranial hemorrhage, were seen in 3 patients. Laceration of the mesentery, liver, or spleen or splenic rupture occurred in 4 patients. Orthopedic injuries—fractures of the pelvis, spine, scapula, hand, or long bones of the extremities—were complicating factors for 15 patients.

Operative Technique

Aortic repair was attempted in 20 patients by means of a left posterolateral thoracotomy. Proximal control of the aorta was gained between the left subclavian and left carotid arteries. In 14 of the 20 patients who underwent repair, the clamp-and-sew technique was used interposing a woven Dacron prosthesis. Aortic cross-clamp time for this procedure averaged twenty-six minutes and ranged from seventeen to thirty-six minutes in 12 of the 14 patients with typical aortic injuries. In 5 patients, a heparin-bonded Gott shunt was used during aortic cross-clamping. The shunt was placed between the aortic arch and the distal aorta in 2, and the aortic arch and femoral artery in 3 patients. Aortic cross-clamp time averaged thirty-eight minutes.

In 2 patients multiple tears were found in the aortic arch, the more proximal of which was identified only during surgery (Figure 1). Repair was effective in 1 patient with use of the clamp-and-sew technique, but at the expense of a prolonged cross-clamp time of sixty-seven minutes. In the second patient, proximal control between the innominate and left common carotid arteries could not be achieved, because the site of injury was at this location. This patient was placed on full cardiopulmonary bypass with hypothermia for the repair. The pulmonary outflow tract and distal aorta were used for cannulation. Cross-clamp time was forty-three minutes.

Table I

<table>
<thead>
<tr>
<th>Type of Repair</th>
<th>Patients</th>
<th>Death</th>
<th>Paraplegia</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Clamp &amp; Sew&quot;</td>
<td>14</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Shunt</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CPB*</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* CPB: Cardiopulmonary Bypass.

Results

The treatment and outcome of 20 patients are summarized in Table I. Two died shortly after opening of the left chest from exsanguination caused by a total disruption of the thoracic aorta and were, therefore, excluded from further analysis. The remaining 20 patients had surgical intervention. Twelve of these patients tolerated the procedure well and developed no postoperative complications relating to distal ischemia. For all 12, cross-clamp time was less than thirty minutes. Two of the 12 patients died postoperatively from complications of concomitant injuries: 1 from sepsis on postoperative day 11 and the other from cardiac arrest on postoperative day 2. Neither of these patients suffered from paraplegia nor liver nor renal failure at the time of death. Two patients undergoing the clamp-and-sew technique suffered from postoperative paraplegia that was not present prior to surgery. Cross-clamp time for these
2 patients was thirty minutes — sixty-seven and forty-three minutes. The patient with a sixty-seven-minute cross-clamp time also suffered from renal failure postoperatively. Of particular note is that this patient had two tears of the distal aortic arch, the more proximal of which was identified only after the aorta was cross-clamped and opened.

In another patient, cardiopulmonary bypass was used. This patient suffered aortic tears at the origin of the left carotid artery in addition to three tears further distal. The distal arch was replaced, and the left subclavian artery was reimplanted into the graft. Cross-clamp time was forty-three minutes. The patient did not experience paraplegia.

In the other 18 patients, aortic injuries were single and distal to the left subclavian artery. A heparin-bonded Gott shunt was placed in 5 patients for perfusion of the distal aorta during cross-clamping. Cross-clamp time for these patients averaged thirty-eight minutes. All lesions were single and located in the distal arch beyond the origin of the left subclavian artery.

Discussion

Rupture of the thoracic aorta in blunt trauma is caused primarily by rapid deceleration causing shearing at points of aortic fixation, such as at the aortic root, the aortic isthmus, or the diaphragm. In 95% of those patients who survive aortic injury long enough to be brought to the hospital, the disruption is at the aortic isthmus distal to the origin of the left subclavian artery. Rupture of the ascending aorta just above the aortic root is second most common, but rupture of the descending aorta above the diaphragm is rare.

A fourth type of aortic injury that is now being seen with increasing frequency is multiple aortic tears located in the proximal aortic arch. This is an exceedingly serious injury occurring in victims of motor vehicle accidents involving very high speeds. The great technical difficulty of the repair of multiple proximal aortic injury compared with that of single-site injury is further complicated by inaccurate visualization with aortography, and, subsequently, inadequate preoperative planning.

Notwithstanding improvements in trauma management and/or anesthetic and operative techniques, the literature continues to testify to the lethality of aortic injury. Although between 80% and 90% of these patients may continue to die at the accident scene, the establishment of a regional trauma center allows for a concentration of experience in dealing with these injuries at a single hospital. Such has been the situation at our institution, where 22 patients with aortic disruption were treated. Two of these patients died before operative repair could be accomplished. Of the remaining 20, 18 were successfully repaired (90%). Unfortunately, 2 of these suffered from postoperative paraplegia.

In our series, all patients suffered from aortic injury at the aortic isthmus distal to the origin of the left subclavian artery. In addition, 2 of the patients had multiple intimal tears of the thoracic aorta. Aortography was not helpful in distinguishing the additional injuries. Particularly noteworthy is the fact that in both of these patients, the locus of the second lesion was the aortic arch proximal to the origin of the left subclavian artery. This complicates repair by making it necessary to obtain greater proximal control of the aorta. The "clamp-and-sew" technique can be hazardous in those patients because it may lead to increased ischemic time, which can contribute to postoperative complications. In both patients who had paraplegia, the cross-clamp time exceeded thirty minutes—the "golden period."

Conclusion

Regionalization of trauma care has allowed for successful management of thoracic aorta disruptions: 90% survival versus 50-60% survival in other series. Ten percent of these patients suffered from
multiple proximal tears in the aortic arch that were not accurately diagnosed by aortography. The surgeon must, therefore, be aware that traumatic aortic disruptions can occur at multiple sites in any individual patients. A high index of suspicion and the increased use of adjunctive techniques such as shunting should help improve the patient’s outcome after these injuries.

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References


