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Comments
Poster presentation at the New England Anesthesia Resident Conference, held on March 24, 2012 in Burlington, VT.
Paraplegia Following Pneumonectomy and Descending Thoracic Aorta Mass Resection

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**Background**

We present a case of paraplegia following an en bloc resection of a lung mass with thoracic aorta involvement. This complex case poses the opportunity to discuss several perioperative issues.

**Fluid management for pneumonectomy:**

Pneumonectomy has a high 30-day mortality rate, with incidences reaching 25%. Acute lung injury (ALI) is a major predictor of mortality in pneumonectomy. Clinical data suggest that fluid volumes >4L within the first 24 hours can contribute to the development of ALI. As a result, conservative fluid management is recommended.

**Fluid management for thoracic aorta clamping:**

Endorgan ischemia in the setting of aortic clamping is minimized by adequate circulating volume and perfusion pressure, which are maintained by administration of saline IV fluids.

**Spinal cord ischemia (SCI):** SCI is a devastating complication of surgical repair of the thoracic aorta. The incidence of SCI with surgical repair of the thoracic aorta has been reported to be as high as 14%, and thoracolumbar leakage has an estimated SCI incidence of 0.026-0.03%.

The patient may present with lower extremity weakness ranging from paraparesis to paraplegia. Moreover, clinical onset of SCI may be immediate or as late as months after the surgery. Prevention of SCI and neurological deficit is not only important in ensuring a better quality of life but also in improving the survival rate.

**Spinal Cord Ischemia Prevention & Management**

<table>
<thead>
<tr>
<th>Spinal Cord Ischemic Event</th>
<th>Intervention</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic Cross Clamp</td>
<td>Improvement of aortic cross clamp perfusion pressure</td>
<td>Minimize aortic clamp time, increase MAP</td>
</tr>
<tr>
<td>Suppression of aortic cross clamp metabolic instability</td>
<td>Moderate passive hypothermia (2°C to 34°C), profound hypotensive circulatory arrest (14-30%): Infusion of cold saline into the intravascular space</td>
<td></td>
</tr>
<tr>
<td>Neuroprotection of the spinal cord</td>
<td>Metabolite precursors, mannitol, melatonin, intrathecal papaverine</td>
<td></td>
</tr>
<tr>
<td>Prevention of steal from collateral arterial networks during aortic cross clamp clamp and opening of aorta</td>
<td>Utilization of both distal aortic and infrarenal arteries, prevention of pharmacologically induced arteriovenous shunting which occurs from use of drugs such as dopamine</td>
<td></td>
</tr>
<tr>
<td>Early detection and intervention of SCI</td>
<td>Invasive monitoring of somatosensory evoked potentials and motor evoked potentials</td>
<td></td>
</tr>
</tbody>
</table>

**Peri-Operative Timeline**

- **First Operation:** Flexible bronchoscopy, mediastinoscopy, left thoracotomy; mass noted to be adherent to descending thoracic aorta. Procedure aborted.

- **Second Operation:** En bloc resection of lung mass with left pneumonectomy, resection of 3cm of descending thoracic aorta and interposition grafting. GETA, thoracic epidural; Aortic cross clamp time = 30 minutes. Operative duration of 8 hours, IABP, 18 ml crystalloid, and 200 ml colloid; UO 260 mL, EBL = 700 mL.

- Upon emergence from anesthesia: Bilateral lower extremity paraplegia with intact sensation. SCI most likely diagnosis; secondary diagnosis of neuraxial hematoma and overdosed epidural catheter. CSF drain placed, 10 mL CSF removed, patient immediately able to flex bilateral hips 25°, PF/FD normal.

**POD Neurologic Pulmonary Renal**

<table>
<thead>
<tr>
<th>POD</th>
<th>Neurologic</th>
<th>Pulmonary</th>
<th>Renal</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-1 Hourly neurological exams</td>
<td>-1 Phrenic nerve for MAP goal = 90 mmHg</td>
<td>-1 Rapid infusion boluses for urine output</td>
</tr>
<tr>
<td></td>
<td>-1 CSF to max 10 ml for CSF Pressure &gt; 10 mmHg</td>
<td>-1 Thoracic epidural</td>
<td>-1 Abnormal CSF drainage</td>
</tr>
<tr>
<td>1-2</td>
<td>-1 Exam unchanged</td>
<td>-1 Nonopine phrine for MAP goal = 90 mmHg</td>
<td>-1 Rapid infusion boluses for urine output</td>
</tr>
<tr>
<td></td>
<td>-1 CSF hourly limit removed and set to 50 ml for CSF Pressure &gt; 10 mmHg</td>
<td>-1 IVP</td>
<td>-1 PD 2: FENa = 0.5</td>
</tr>
<tr>
<td>3-4</td>
<td>-1 Exam unchanged</td>
<td>-1 Nonopine phrine for MAP goal = 90 mmHg</td>
<td>-1 Rapid infusion boluses for urine output</td>
</tr>
<tr>
<td></td>
<td>-1 CSF clamped on PCD2</td>
<td>-1 IVP</td>
<td>-1 PD 2: Nonoliguric ATN, multiple muddy brown cast under microscopy</td>
</tr>
<tr>
<td>7-D/C</td>
<td>-1 Exam unchanged</td>
<td>-1 Discharged to Rehab on POD 5</td>
<td>-1 NSN</td>
</tr>
<tr>
<td></td>
<td>-1 Discharged to Rehab on POD 5</td>
<td>-1 Discharged to Rehab on POD 6</td>
<td>-1 See fig 2.</td>
</tr>
</tbody>
</table>

**Discussion**

The major intra-operative challenge of this case was the conflicting goals in fluid management for concomitant pneumonectomy and thoracic aorta resection. A conservative approach was taken to fluid management. Although it is difficult to be certain, unavoidable intravascular volume and hypotension around the time of aortic clamping and release may have contributed to renal injury and SCI. Conversely, the patient’s favorable post-operative pulmonary function may have been attributable, at least in part, to the conservative fluid strategy.

Fluid management decisions in the setting of recent pneumonectomy and acute kidney injury posed a post-operative challenge. The incidence of renal failure related to thoracic aorta surgery is as high as 15%. Indeed, this patient developed post-operative AKI. Intraoperative volume maintenance is thought to reduce the risk of kidney injury. In the ICU, the patient was given little maintenance IV fluids and intermittent post-operative diuretics were used with limited success in achieving a balance between conservative fluid management for optimal pulmonary function and aggressive fluid administration aimed at minimizing any further renal injury. Urine output was maintained and renal function returned without need for dialysis.

The incidence of SCI with surgical repair of the thoracic aorta may be up to 14%. Maintenance of adequate mean arterial pressure and thus SCI perfusion pressure is paramount in limiting SCI. Typically, first-line management for maintenance of MAP is fluid administration, then vasoconstrictors. As discussed above, aggressive IV fluids were avoided, thus, vasoconstrictors were used for isolated blood pressure goals.

Furthermore, the patient did not make use of any of the SCI therapies described in the literature.

**References**


**Abbreviations**

ALI: Acute Lung Injury; ATN: Acute Tubular Necrosis; CSFD: Cerebral Spinal Fluid Drain; CXR, Chest X-Ray; DCA: Distal Aortic Perfusion; DCC: Distal Celiac Compromise; EBL: Estimated Blood Loss; EEC: Endocardial Excision; GETA: General Endotracheal Anesthesia; GIK: Glucose, Insulin, and Urokinase; IT: Intrathecal; LSA: Local Anesthetic; LUM: Lumbar Epidural Anesthesia; Methylprednisolone, mannitol, naloxone, and phenytoin; MAP: Mean Arterial Pressure; NSN: No significant neurologic deficit; PPOC: Peroperative Day; SC: Spinal Cord; SCI: Spinal Cord Ischemia; UO: Urine Output; WBC: White Blood Cell.