Abdominal complications following posterior spinal fusion in patients with previous abdominal surgeries

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Perioperative abdominal complications associated with spine surgery are rare. Although most known abdominal complications occur in conjunction with anterior spinal fusions, there is a paucity of reports reviewing abdominal complications occurring with posterior spinal fusions. The authors review 4 patients who experienced a perioperative abdominal complication following a posterior spinal fusion. In each of these patients, a history of abdominal surgery is present. Given the physiological changes that occur with surgery in the prone position, patients with previous abdominal surgeries are at risk for developing abdominal complications in the perioperative period. (DOI: 10.3171/2011.8.FOCUS11132)

Keywords • posterior spinal fusion • abdominal complication • abdominal compartment syndrome • hernia

Spine surgery is associated with perioperative morbidity and mortality in the adult population. Poor outcomes can be related to abundant blood loss associated with large fusions or advanced patient age. An understanding of relevant risk factors is important in minimizing morbidity and mortality. Although abdominal complications are uncommon in spine surgery, they have been reported to occur in patients with anterior spinal fusion. Furthermore, spinal manipulation for the correction of scoliotic deformity can lead to superior mesenteric artery syndrome when the superior mesenteric artery places compression on the duodenum. Recently, abdominal complications, in particular ACS, have been described in patients with posterior spinal fusions. The authors present a series of patients with a history of abdominal surgery who experienced an abdominal complication following a posterior spinal fusion.

Methods

The authors conducted a retrospective review of a series of posterior spinal fusions performed in the Department of Neurological Surgery at Northwestern Memorial Hospital between September 2009 and August 2010. Approval to conduct the study was obtained from the institutional review board prior to its initiation. During this period, a chart review was performed in all patients with prior abdominal surgery who had undergone a posterior spinal fusion and suffered an abdominal complication requiring intervention during the perioperative period. For each patient, the BMI and the number and nature of prior abdominal surgeries are documented. The description of the spine procedure, time of surgery, estimated blood loss, urine output, intraoperative fluid given, abnormal results of intraoperative laboratory tests, and the amount of required transfusion is recorded. For any patient with an abdominal complication, the length of time between the date of the operation and the date of the diagnosis of complication, the nature of the injury, and any surgical intervention are noted.

Results

One hundred sixty-six patients were found to have undergone a posterior lumbar fusion between September 2009 and August 2010. In this group, 55 patients had undergone a previous abdominal surgery, and 4 of these 55 patients (7.2%) had an abdominal complication in the perioperative period following their spine surgery. There were 111 patients with no history of abdominal surgery. No patients in this group had a related abdominal complication.
Case Reports

Case 1

**History and Examination.** This patient was a 79-year-old morbidly obese (BMI 44) woman with a medical history significant for hypertension, elevated cholesterol, obstructive sleep apnea, and gastroesophageal reflux disease. She had an extensive surgical history that included a cholecystectomy and exploratory laparotomy for a colon perforation many years previously. She had also undergone a left L5–S1 minimally invasive foraminotomy in 2007 for a unilateral radiculopathy. The patient presented to clinic several years later with progressive low-back pain as well as neurogenic claudication. Multiple modalities of nonoperative management had failed in this patient.

**Operation.** The patient ultimately consented to and underwent an L4–5 transforaminal lumbar interbody fusion. Pertinent operative details include positioning on an open Jackson table. Given her morbid obesity, there was some difficulty in containing the patient’s abdomen with the Jackson table. The procedure itself was unremarkable, with a total estimated blood loss of 50 ml, and the operating time was 165 minutes. She did not require a transfusion intraoperatively and there were no abnormal laboratory values in the perioperative period. The patient received 2 L of crystalloid and 500 ml of hextan during the operation. No Foley catheter was placed for the operation and no urine output was recorded. The patient was extubated in the operating theater and transferred to the postanesthesia care unit. Her neurological examination was unchanged from her preoperative status.

**Postoperative Course.** Once she was stable, the patient was transferred to the general neurosurgical floor. On the 1st postoperative day the patient worked with the physical and occupational therapists and began to ambulate. An anteroposterior and lateral lumbar spine x-ray study obtained on the 1st postoperative day revealed acceptable positioning of the interbody cage and posterior instrumentation. On the 3rd postoperative day the patient began to experience increased nausea, with 2 episodes of emesis. She had already had a small bowel movement. An abdominal film did reveal findings of a partial small-bowel obstruction secondary to a right inguinal hernia. Due to progressive nausea and vomiting, the patient had a nasogastric tube placed later the evening. The general surgery service was also consulted. She exhibited minimal tenderness to palpation, but no guarding or peritonitis. The patient’s clinical status improved with nasogastric drainage. A CT scan of the abdomen and pelvis revealed transition points in the vicinity of the fascial defect of abdominal wall (Fig. 1). There was no free air. By the afternoon of postoperative Day 4, the patient’s status deteriorated and she began to demonstrate signs of peritonitis. The patient’s clinical status improved with nasogastric drainage. A CT scan of the abdomen and pelvis revealed transition points in the vicinity of the fascial defect of abdominal wall (Fig. 1). There was no free air. By the afternoon of postoperative Day 4, the patient’s status deteriorated and she began to demonstrate signs of peritonitis. On the 4th postoperative day, the patient was taken to the operating room by general surgery for an exploratory laparotomy and reduction of 5 different incarcerated hernias. The patient experienced a prolonged hospital course, which included 2 weeks in the surgical intensive care unit. Her open abdominal wound was eventually partially closed with a vicryl mesh and negative pressure wound therapy. She was ultimately discharged to a skilled nursing facility on postoperative Day 31.

Case 2

**History and Examination.** This patient was a 61-year-old morbidly obese (BMI 51) woman with a medical history significant for hypertension, hypothyroidism, pulmonary embolus on warfarin, chronic renal failure on dialysis, and a remote history of bacterial peritonitis due to mesenteric ischemia in 1992. At that time she underwent partial colectomy and temporary ostomy placement. This course was complicated by *Candida* osteomyelitis, for which the patient underwent 2 prior thoracolumbar operations (T4–L3 posterior instrumentation and fusion). She was evaluated in the outpatient setting for many years for progressive low-back pain and neurogenic claudication. Ultimately, she consented to and underwent an L3–4 laminectomy and revision of her prior fusion at L-1 and extension to S-1 and the ilium. She also had an inferior vena cava filter placed at the time of this operation.

**Operation and Postoperative Course.** The duration of her operation was 630 minutes. During the case, the patient received 2.7 L of crystalloid, 4.5 L of colloid, 5 U of packed red blood cells, 3 U of platelets, and 1 U of cryoprecipitate. The estimated blood loss was 2.7 L, and urine output was 570 ml. The only abnormal immediate postoperative value was a hemoglobin level of 11.3 g/dl. On postoperative
Abdominal complications with posterior spinal fusion

Day 5 the patient experienced increasing epigastric pain, and an abdominal x-ray showed a large dilated loop of colon in the midabdomen. The general surgery service was consulted and an abdomen/pelvis CT scan was obtained, which showed a nonobstructive pattern of gas and findings consistent with an ileus. A nasogastric tube was placed and she improved clinically. However, in the early afternoon of postoperative Day 6, the patient exhibited signs and symptoms of peritonitis. She was taken to the operating room by the general surgery service for an exploratory laparotomy, lysis of adhesions, small-bowel resection, and repair of perforation in the distal small bowel. She subsequently underwent multiple explorations and anastomotic repairs. After a prolonged hospitalization the patient recovered, with the exception of her renal failure. She developed sepsis and eventually Enterobacter cloacae infection was made; the patient underwent instrumentation and immunotherapy. The patient did well for a period of time until he developed progressive low-back pain and was found to have necrosis of L-5. Before presenting to our institution, he underwent an anterior approach for corpectomy, which was aborted due to extensive scarring and resulted in posterior instrumentation being placed. His postoperative course was complicated by a methicillin-resistant wound infection, which resulted in numerous surgical interventions to repair the instrumentation and wound. He then developed wound dehiscence, and a diagnosis of recurrent methicillin-resistant Staphylococcus aureus infection was made; the patient underwent instrumentation removal and transferred to our institution for definitive surgical management.

Operation. Once he was admitted to our institution, the patient’s care was co-managed by several services, including the general medicine, infectious disease, and gastroenterology services. He eventually underwent 2 different surgeries as part of a larger surgical plan. The first stage was an exploration of his prior thoracolumbar wound and removal of his remaining instrumentation. This operation lasted 100 minutes. The estimated blood loss from this operation was 50 ml, and the urine output was 300 ml. No transfusions were given. Additionally, the patient received 1.5 L of crystalloid and 500 ml of hetastarch solution.

He recovered from the first stage without issues, and 1 week later was brought back to the operating room for the second stage of the procedure. The second stage consisted of a posterior instrumentation and fusion from L-2 through S-1 with iliac screw placement. The operation included a transiliac bar and a 4-rod lumbosacral construct. The L-5 pathological condition was addressed with a right partial L-5 pediculectomy, revision of the prior L-5 corpectomy, and irrigation and debridement of osteomyelitis. Additionally, a custom-cut titanium cage was inserted into the L5–S1 disc space to achieve stability and serve as a site for fusion. The wound was closed by our plastic surgery colleagues by using 2 different flaps, as follows: 1) a superior gluteal artery pedicled flap for the midline; and 2) a latissimus dorsi V-Y myocutaneous flap. This operation lasted 626 minutes. Intraoperatively, the patient received 5 L of colloid, 2 L of crystalloid, and 8 U of packed red blood cells. The estimated blood loss was 2.8 L. Urine output was 2.9 L.

Postoperative Course. Following the operation, he had an uneventful hospitalization and was discharged to a rehabilitation facility on postoperative Days 17 and 24. On postoperative Days 22 and 29, the patient was brought to our institution’s emergency department with progressive abdominal pain. He was evaluated by the general surgery service and a CT scan showed a small-bowel obstruction with an incarcerated hernia (Fig. 2). The patient was taken to the operating room for emergency exploratory laparotomy and reduction of the incarcerated hernia. He had an uneventful recovery and was transferred back to his original rehabilitation facility on postoperative Day 6 after the laparotomy.

Case 4

History and Examination. This 48-year-old obese (BMI 30) woman had a medical history of mitral valve prolapse, obstructive sleep apnea, and irritable bowel syndrome. Her surgical history included 4 different ventral hernia repairs and adolescent scoliosis correction with Harrington rods. The patient was evaluated in the out-

Fig. 2. Case 3. Axial CT scan of the abdomen and pelvis demonstrating a high-grade bowel obstruction secondary to an anterior abdominal wall hernia containing small bowel.
Operation and Outcome. Due to her medical comorbidities and nature of the planned surgical interventions, the patient had an inferior vena cava filter placed during the first surgery. The patient had been under general anesthesia and in the prone position for approximately 10 hours when she experienced frank disseminated intravascular coagulation. At this point in the case, all instrumentation had been placed and the surgeon had just completed a pedicle subtraction osteotomy and final rod placement. At that time, her cumulative total blood loss was 6000 ml and she had received 2000 ml of crystalloid, 1900 ml of red blood cells from the cell saver, 3000 ml of 5% albumin, 11 U of packed red blood cells, 3 U of platelets, and 4 doses of pooled cryoprecipitate. Her hemoglobin was 13.0 g/dl, she had a platelet count of 115,000, international normalized ratio 1.4, fibrinogen 239 mg/dl, and her arterial blood gas had a pH of 7.41, PCO 2 of 31, PO 2 of 205, and a base deficit of −4. While the closing staples were being placed, the patient developed a junctional bradycardia with an arterial line systolic blood pressure of 98, diastolic blood pressure of 88, and mean arterial pressure of 90 mm Hg; she subsequently developed pulseless electrical activity. She was emergently returned to the supine position. It was clear that her abdomen was tense and distended. A bladder pressure was transduced via the Foley catheter that was noted to be approximately 100 mm Hg. A decision was made to proceed with emergency exploratory laparotomy for presumed ACS. Despite opening the abdomen, there was no improvement in her circulation or rhythm. In addition, there were no sites of massive hematoma in the intraperitoneal or extraperitoneal spaces. The entire bowel was dusky and ischemic in appearance. Because of the futility of further efforts to resuscitate the patient, she was pronounced dead. The presumptive cause of death was ACS.

Discussion

Abdominal compartment syndrome is a potential complication occurring in high-risk spine surgery cases involving multilevel thoracolumbar fusion. These patients are at risk because of mechanical ventilation, fluid resuscitation, acidosis, coagulopathy, and polytransfusion. A history of abdominal surgery places these patients at additional risk for developing ACS. Tight abdominal closures can alter the compliance of the abdomen. Physiological changes that occur in the prone position are believed to contribute to abdominal complications. In the prone position, visceral compression further contributes to alterations of wall compliance. Abnormal values of IAP (> 12 mm Hg) can raise concern for the development of ACS. Initial management of intraabdominal hypertension should be focused on correcting any positive fluid balance. Maintaining abdominal perfusion pressure > 60 mm Hg is favored to prevent multiorgan failure. Abdominal decompression is reserved for intraabdominal hypertension refractory to medical therapy.

Any signs suggesting multiorgan failure during an operation should raise concern of a possible ACS. A drop in systolic or diastolic blood pressure, a rise in PCO 2, a drop in O 2 saturation and PO 2, and a drop in urine output have all been shown to correlate with increased IAP. Laboratory tests should be obtained periodically for any indication of coagulopathy or abnormal base deficit. Fluid balance should be strictly monitored. If there is evidence of abnormal laboratory test values, a decision should be made to stage the procedures. If high blood loss is suspected in a patient undergoing multilevel fusion who has had previous abdominal surgeries, is obese, and whose age is advanced, an intravesicular transducer should be considered to monitor IAPs during the procedure. Emergency surgical decompression is warranted and can be immediately life saving if the suspicion for ACS is high. Delay in surgery has been shown to have bad outcomes.

Small-bowel obstruction related to a physical impingement of the small bowel is not a known, documented complication of prone positioning. However, there are several factors that are believed to contribute to small-bowel obstruction in the setting of prone positioning used in posterior spinal fusion. Correlations have been seen between elevated IAP and prone position with spine surgery. Three of 4 patients experiencing abdominal complications in this series were obese. With obese patients, the IAP is elevated compared with those with a normal BMI. The risk of incisional hernia is also higher in obese patients. Thus, these considerations must be factored into the preoperative assessment of patients with previous abdominal surgery who are at risk for incisional hernia and subsequent small-bowel obstruction.

For obese patients, a Jackson table can be used to provide less pressure on the abdomen by allowing it to hang free. However, there is a theoretical risk of increased IAP caused by fluid extravasation from the gravitational and hydrostatic pressures in the dependent area of the abdomen with obese patients. External abdominal support is not recommended because it can cause changes in compliance of the abdomen. Pressure points should be checked to insure that there is no focal impingement in any portion of the abdomen. For patients with known inguinal hernia and advanced age, abdominal hernias leading to emergency operations are associated with significant rates of morbidity and mortality.

As these cases demonstrate, special consideration should be given to details of the placement in the prone position to prevent the development of an incarcerated or strangulated hernia. There should be a high suspicion for small-bowel obstruction in the postoperative period in any patient with increasing abdominal pain, worsening nausea and vomiting, or the absence of flatus and bowel movements. Physical examination assessing for a distended, rigid abdomen or evidence of an irreducible hernia should prompt workup with radiography and/or CT scanning of the abdomen and pelvis. Elevated lactate acid can occur with mesenteric ischemia and can be a reliable marker for early bowel ischemia. If signs and symptoms are suggestive of small-bowel obstruction, a nasogastric tube should be placed to provide decompress-
Abdominal complications with posterior spinal fusion

Complications of spinal fusions are associated with the nature of the operation and predisposing risk factors. Despite the low incidence, there can be some significant abdominal complications occurring in patients with previous abdominal surgeries who elect to undergo posterior spinal fusions. The physiological changes that occur during operation in these cases can escalate this risk of surgery. The key to preventing a complication in these situations is awareness and early intervention.

Conclusions

Complications of spinal fusions are associated with the nature of the operation and predisposing risk factors. There are select cases in which patients who demonstrate a hernia or who have a history of hernia repair warrant a general surgery consultation prior to the procedure. These cases include any surgery in which there is an anticipated need for blood transfusions, the patient is obese, or the hernia is irreducible. Treating the hernia prior to surgery can prevent an unwanted abdominal complication.

Disclosure

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References


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5

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