Low back pain (LBP) is a prevalent condition, particularly in primary care clinics, with billions of dollars spent each year on treatment.\(^3\) It is the fifth most common reason for all physician visits in the United States.\(^1\) Approximately 25% of adults report LBP lasting at least 1 day within the past 3 months,\(^1\) with approximately 14% having an episode that lasts longer than 2 weeks.\(^1\) Prevalence ranges from 15% to 20% over a single year\(^4\) and approximately 70% over the course of a person’s lifetime.\(^1,2,7,10,14\)

The majority of patients (>85%) with LBP have conditions that cannot be reliably attributed to a specific disease or spinal abnormality.\(^11,15\) Current recommendations suggest classifying patients into 3 broad categories: nonspecific LBP, nerve root syndrome (radiculopathy or stenosis), and serious spinal pathology.\(^1,13,30\)

LBP secondary to nerve root syndrome, although less common, is a potentially disabling condition.\(^2\) Nerve root syndrome may be related to radiculopathy, spinal stenosis, or cauda equina syndrome (CES).\(^2\) Due to the potential for poor prognosis, timely recognition of neurologic involvement is essential for optimal patient outcomes.\(^2\)

Acute lumbar disc herniation is one potential source of both radiculopathy and CES. Approximately 90% of cases of sciatica are caused by a herniated disc.\(^29\) Overall incidence of symptomatic disc herniation is 1% to 2%,\(^2,29,39\) for which 200,000 discectomies are performed annually.\(^39\) Peak incidence of this disorder is between the ages of 30 to 55 years.\(^12\)

Characteristics of acute disc herniation include abrupt, intense onset of pain that is increased by bending or lifting.\(^48\) The most common levels of symptomatic herniation are L5-S1 and L4-5, which comprise approximately 90% to 98% of cases\(^31,15\) and correspond to the spinal levels that receive the majority of compressive forces in the lumbar spine. Clinically, disc herniation at these levels frequently manifests as L5 and S1 nerve root compression disorders characterized by radiating pain below the knee.
decreased sensation in a dermatomal pattern, myotomal weakness, reflex changes, and positive straight-leg raise tests. However, examination of patients with acute disc herniation should always include careful screening for serious pathology, both before initiation of and during ongoing conservative interventions. Red flag differential diagnoses may include CES, metastatic spinal disease, spinal infection, epi- dural hematoma, and spinal fracture or dislocation. Screening for red flag conditions should include questions regarding bowel and bladder function changes, sensory function changes in the perianal region and genitals, unexplained weight loss or gain, fever, night pain, history of cancer or infection, history of trauma, and any gait disturbances (TABLE 1).

In adults, the spinal cord is approximately 42 to 45 cm in length and terminates at the lower border of the first lumbar vertebra in the thoracic vertebrae or upper border of the second lumbar vertebra at the conus medullaris. The spinal cord is ensheathed by three protective membranes from outward to within: the dura mater, arachnoid, and pia mater. These membranes extend to the first segment of the coccyx as the filum terminale. The outer layer of the dura, arachnoid, and the subarachnoid cavity is termed the thecal sac, which is filled with cerebrospinal fluid.

The term cauda equina describes the lumbar and sacral spinal nerves descending from the conus medullaris. During embryo development, the spinal cord and vertebral column have relatively unequal rates of growth. As a result, the lumbar and sacral spinal nerves descend almost vertically to reach their points of exit. This configuration resembles a “horse’s tail,” from which the term cauda equina is derived in Latin.

CES is a rare, potentially devastating disorder that may arise from an acute disc herniation and is considered a true neurologic emergency. The estimated prevalence of CES is 0.04% of all patients presenting with a primary complaint of LBP, and it is most prevalent in the fourth or fifth decade of age. CES occurs in 1% to 2% of all lumbar disc herniations that progress to surgery.

CES is most frequently associated with a nontraumatic massive midline posterior or disc herniation, commonly located at L4–5, followed by L5–S1 and L3–4. The sacral nerves, which lie medially in the cauda equina, are affected disproportionately in this disorder. A clear diagnosis or a high index of suspicion for CES should prompt immediate referral to a surgical specialist. Referral to an orthopaedic spine surgeon or neurosurgeon, where available, is the most direct route of referral; otherwise, the patient should be sent to an emergency department.

The purpose of this resident’s case problem is to describe the evaluation, treatment, referral, and outcomes of a patient exhibiting signs and symptoms of CES evaluated by a physical therapist in a direct-access environment.

### TABLE 1

<table>
<thead>
<tr>
<th>Red Flags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrelenting night pain</td>
</tr>
<tr>
<td>History of cancer or recent infection</td>
</tr>
<tr>
<td>Unexplained weight loss or gain</td>
</tr>
<tr>
<td>Recent trauma</td>
</tr>
<tr>
<td>Difficulty with micturition*</td>
</tr>
<tr>
<td>Loss of anal sphincter tone or fecal incontinence*</td>
</tr>
<tr>
<td>Saddle anesthesia*</td>
</tr>
<tr>
<td>Gait disturbance*</td>
</tr>
</tbody>
</table>

* Indicates elements specific to cauda equina syndrome.

### DIAGNOSIS

#### History of Present Illness

The patient was a 32-year-old Caucasian male (height, 1.83 m; body mass, 77.1 kg; body mass index, 23.1 kg/m²) who initially presented to a physical therapist in a combat zone with a chief complaint of insidious onset low back and left posterior thigh pain. He was deployed for combat with a primary responsibility of training foreign military officers. During convoy operations, he was a machine gunner, standing in the turret at the top of an armored vehicle. This job required prolonged periods of wearing protective equipment weighing in excess of 36 kg, often for periods exceeding 8 hours. His symptoms were located in the lower lumbar spine (left greater than right), left buttock, and left posterior thigh, as shown in FIGURE 1. The total duration of symptoms was approximately 4 weeks, but the patient reported a significant increase in intensity of pain the day prior to evaluation without any specific trauma. He described a dull, aching pain, and a pain that was intermittently sharp. The patient denied numbness or tingling in any location or pain below the level of the knee. Baseline numeric pain rating scale (NPRS), where 0 is no pain and 10 is the worst pain that the patient could imagine, was 4/10 at rest and 7/10 at worst. The patient noted increased pain with running and forward flexion of the lumbar spine. Rest and lying supine relieved his symptoms. His past medical history was significant for 3 to 4 prior occurrences of LBP over the past 8 years, with similar presentation that, he stated, resolved without treatment. The patient had no history of spine or extremity surgery. No previous imaging studies had been performed. His stated goal was to decrease his overall pain level during performance of his military duties.

#### Systems Review

The patient denied saddle anesthesia, bowel or bladder function changes, unexplained weight loss or gain, night pain, or
recent trauma, and had no history of cancer or infection. In screening for nonmusculoskeletal pathology, the patient reported no history of cancer, cardiovascular, or pulmonary disease, and no recent occurrence of nausea, vomiting, fever, changes in appetite, difficulty swallowing, shortness of breath, dizziness, or changes in balance.

**Test and Measures**

The patient was neurologically intact bilaterally with 5/5 strength as assessed with manual muscle testing throughout the L2 to S1 myotomes, sensation was intact to light touch throughout the L2 to S1 dermatomes, and knee jerk and ankle jerk muscle stretch reflexes were 2+ (normal). Babinski reflex testing was negative. He presented with decreased lumbar lordosis and a guarded, obviously painful, movement of the spine. The patient displayed a left-sided antalgic gait, with decreased left hip extension and early termination of the stance phase of the gait cycle. Active range of motion was severely limited in lumbosacral flexion, with the ability to reach only the mid-anterior thigh region with the fingertips, and moderate to severe pain in the low back, left buttock, and left posterior thigh at the end range of motion. Lumbosacral extension and side bending were within normal limits, without an increase in pain from his baseline NPRS. Repeated-motion testing was performed as described by McKenzie. Ten repetitions of flexion in standing increased his back, buttock, and posterior thigh pain, while 10 repetitions of extension in standing reduced those symptoms. Straight-leg raise tests did not produce radicular pain but caused a severe increase in LBP at 15° of hip flexion on the right and 45° of hip flexion on the left. Hip flexion range of motion during single knee to chest was within normal limits bilaterally, with increased LBP that was approximately 50% less than with straight-leg raise testing. A lumbar quadrant test was negative bilaterally. Passive vertebral motion testing, as described by Maitland, produced local pain at L3, L4, and L5 with central passive posterior-anterior accessory intervertebral motion (PAIVM). Unilateral PAIVM testing produced local pain at L3-4, L4-5, and L5-S1, equal bilaterally. No referral of pain was noted with passive accessory movement assessment.

**Assessment, Intervention, and Re-evaluation**

Using a treatment-based classification approach, the patient was classified into the specific exercise classification and prescribed extension-oriented exercises. Either standing or prone repeated extension exercises were to be performed every 2 waking hours, with 10 repetitions, holding each repetition 2 to 3 seconds at end range. Education consisted of avoidance of sitting for greater than 20 to 30 minutes, avoidance of full end-range flexion positions, and the use of a lumbar roll while sitting and wearing protective equipment. The treating physical therapist, who had privileges for prescribing nonnarcotic medication, prescribed 7.5 mg Meloxicam (Mobic, 2 tablets once daily) and 500 mg acetaminophen (Tylenol, 2 tablets every 4–6 hours, as needed) for pain relief during performance of his military duties. Because this patient was essential to the success of his unit’s mission, only a home exercise program was prescribed, and a follow-up was scheduled for 2 weeks later. He was instructed to return to the clinic at an earlier time for re-evaluation if symptoms worsened.

The patient presented for follow-up on day 4 (3 days after the initial evaluation) with a complaint of increased pain unrelied by positioning and only short-term relief with the home exercises program. His baseline NPRS at rest had increased to 6/10. He reported a decreased NPRS to 4/10 after performing home exercises, but he would return to baseline after approximately 30 to 60 minutes. Since the initial evaluation, he had continued to perform all of his duties, including extended wear of protective equipment. The physical examination, including the neurological examination, did not differ from the initial evaluation, with the exception of increased pain with all testing. His case was discussed with a physician and he was prescribed a narcotic pain medication for use as needed, re-educated in the home exercises to ensure proper performance, and instructed to continue the home exercises as tolerated. The pa-
tient was to follow-up within 1 week to monitor the stability of his symptoms and assess his response to the modified treatment plan.

At a second follow-up 3 days later (day 7 after initial exam), the patient continued to have significant pain. He was able to perform his duties, but the sharp pain was becoming more frequent and intense. He also reported a recent onset of numbness in his left posterior thigh. He continued to deny any radiating pain below the knee or right-sided symptoms. The physical exam was unchanged from initial evaluation and a neurological assessment continued to reveal no motor, sensory, or reflex deficits bilaterally. Although strength of left ankle plantar flexion was 3+/5, he was limited by pain secondary to a recent ankle inversion sprain on rocky, uneven terrain, which he described as unrelated to his low back symptoms and had occurred between the first and second re-evaluation.

Due to increasing pain despite conservative therapy and medications, he was restricted from missions that required the wear of his protective gear and from any lifting, bending, or twisting. Daily physical therapy intervention in the clinic was initiated at that time. The therapist chose to continue with a supervised exercise program and adjunct pain-relieving modalities, because the high-load demands of this patient’s work duties up to that point made accurate assessment of the patient’s response to treatment difficult. Intervention consisted of interferential electrical stimulation with 4 pads bracketing the symptomatic area of the lumbar spine, the patient positioned in prone, and the intensity at the patient’s level of tolerance. Treatment was combined with moist heat for 20 minutes, followed by supervised extension exercises and left lumbar rotation stretches, both of which provided mild relief of the lower extremity pain. Lumbar extension exercises consisted of 3 sets of 10 repetitions, with a 2- to 3-second hold at end range, without manual overpressure. Lumbar left rotation stretching consisted of 30-second holds, with 3 repetitions. The patient’s home exercise program remained unchanged from the initial evaluation.

Upon presenting for his third day of in-clinic treatment (10 days after initial evaluation), the patient had a new complaint of numbness and tingling in the saddle region and a change in bowel and bladder function. Although he denied any incontinence, he stated that it was difficult to control initiation and cessation of urination and bowel movements. The patient also described new symptoms in the right lower extremity (previously asymptomatic), with an inability to rise up onto his toes and constant tingling in the right calf, while his left lower extremity symptoms were unchanged from the last evaluation. **Figure 2** shows the body chart associated with the new symptom presentation. He stated, however, that his pain level had decreased to 4/10 at rest and 5/10 at worst since he stopped wearing his protective gear 2 days prior.

A detailed physical examination was performed, with an orthopaedic physician assistant on staff providing further guidance on neurological assessment of the S3–4 levels. Lumbar spine range of motion was unchanged from the initial evaluation. A straight-leg raise test bilaterally continued to provoke symptoms only in the low back region. No sensory deficiencies to light touch or sharp-dull stimuli were noted throughout the lower extremities bilaterally, including the L4–S1 dermatomes. Strength was reduced in right ankle plantar flexion to 3–/5. The right ankle jerk (S1) reflex was absent. A rectal examination revealed decreased anal sphincter tone and an absent anal wink reflex. The cremasteric reflex was intact. The Babinski reflex was normal. Gait was severely impaired with a decreased step length bilaterally and impaired toe-off present on the right.

**Referral**

Because of his rapidly progressive neurological symptoms and a suspicion of cauda equina compression, the physical therapist scheduled the patient for medical evacuation and referral to a neurosurgeon. No advanced imaging was performed, as magnetic resonance imaging (MRI) and computed tomography (CT) scan capabilities were not available at the local facility. Evacuation to neurosurgery care and advanced medical imaging occurred within 48 hours.
Neurosurgical and Immediate Postoperative Care

Upon arrival at a Combat Support Hospital, the patient was evaluated by a military neurosurgeon. Physical examination findings were consistent with those at the medical aid station. Additionally, bladder function was evaluated and the patient was found to have a postvoid residual of 300 cc. Although MRI is the recommended imaging modality for CES, because of the detail provided to the soft tissues and spinal canal, it was not available in that location either. Instead, a CT of the lumbar spine with contrast, an alternate recommendation to image CES, was performed. The findings reported by the radiologist were suggestive of underlying pathology that could be clinically correlated with CES (Table 2).

Following neurosurgical evaluation, he was prepared for immediate surgical intervention. A L4-5 laminectomy and decompression was performed and a large extruded disc fragment was removed from the epidural space. The next day the patient was evacuated to Landstuhl Regional Medical Center in Germany for inpatient recovery. Three days postsurgery, he was evaluated by a physical therapist. He had an NPRS of 2/10, continued complaints of bowel and bladder dysfunction, and continued right calf weakness. He was independent in bed mobility, edge-of-bed activities, and sit-to-stand transfers. Right ankle plantar flexion was 3+/5, but the patient was able to independently ambulate approximately 18 m. The patient was instructed in ankle pumps along with progressive ambulation to prevent deep venous thrombosis and, to enhance functional recovery, with lower extremity exercises aimed to maintain nervous tissue mobility to prevent postoperative nerve root scarring. After 3 days in Germany, the patient was then evacuated to his final destination, Brooke Army Medical Center, Fort Sam Houston, TX, for follow-up neurosurgical care and recovery.

Recovery and Outcome

The patient arrived at Brooke Army Medical Center 6 days after surgery. An MRI performed on admission demonstrated normal postoperative changes and no residual disc herniation. During his first neurosurgery postoperative evaluation, he presented with right buttock pain, resolving saddle paresthesia, numbness of the right lateral foot region and toes, bladder incontinence, and erectile dysfunction. Ankle and knee muscle stretch reflexes on the right were hypoactive, but he had 5/5 strength throughout both lower extremities. Within 1 week he returned to neurosurgery with some residual right buttock and foot symptoms, resolved saddle paresthesia, and normal reflexes. He was cleared by the surgeon for medical convalescent leave for 30 days, with an intended referral to a physical therapist upon return. Upon return from convalescent leave (approximately 6 weeks after surgery), he had regained full sensory function and continued to demonstrate normal motor function. No referral was made to physical therapy, and the patient was cleared by the surgeon to progress his walking distance as tolerated and start stationary bike exercising. By 12 weeks, the patient had self-progressed to walking 1.6 km daily, doing pool exercises at home, and using 1- to 2-kg weights for upper extremity exercises. At 4-month follow-up he had no residual neurological or functional deficits and reported a current walking program with a 5-kg backpack. He was cleared by neurosurgery for full return to military duties, including redeployment.

### DISCUSSION

This resident’s case problem describes what could be considered a classic presentation of CES, recognized by a physical therapist practicing in a direct-access setting. By a continual medical-screening process over multiple visits, the therapist recognized an atypical progression of mechanical LBP, which then acutely manifested itself as CES. Early recognition, confirmation, referral, and surgical intervention were associated with a good outcome, consistent with literature that suggests a good prognosis with early detection and treatment.

### Mechanical LBP

The patient in this case initially presented with a history and physical examination findings consistent with nonspecific mechanical LBP and no red flag signs or symptoms. Recent research supports the use of a treatment-based classification approach for acute LBP of this nature. Due to centralization of his symptoms with repeated movement in extension, this patient was classified into the specific exercise classification based upon the first step in the algorithm described by Fritz et al. Browder et al examined the effectiveness of an extension-oriented treatment approach in a subgroup of patients with LBP extending distal to the buttocks that centralized with extension movements. In patients meeting these criteria, treatment using extension-oriented exercises resulted in significantly greater reduction of pain and disability than treatment using lumbar stabilization exercises. Additionally, Long et al demonstrated that patients...
with a movement directional preference for symptom reduction (extension in this case) significantly improved when performing specific exercises in that direction as opposed to general exercise, and worsened performing exercises in the opposite direction.

**Nerve Root Dysfunction**

The current case describes mechanical LBP without initial evidence of nerve root dysfunction, which rapidly progressed to CES. A thorough evaluation is essential for accurate identification of LBP with nerve root syndrome and CES. The patient history should include any potential mechanisms of injury, the location, description, nature, and intensity of pain, the presence or absence of any sensory abnormalities, aggravating factors, easing factors, and past medical history. The physical examination should include a neurologic screen, an assessment of lumbar sacral range of motion, assessment of passive vertebral motion, the straight-leg raise test, tests for muscle flexibility, and tests for sacroiliac dysfunction. Sensitivity, specificity, and likelihood ratios for various physical examination and historical items with respect to nerve root syndrome are listed in **Table 3**.

In general, information from the patient history is better for ruling out nerve root syndromes and the physical examination is better for ruling in. Significant indicators of nerve root syndrome include focal muscle weakness and limited lumbar flexion, as indicated by a large finger-to-floor distance. Other predictors may include lower extremity pain that is greater than back pain, a dermatomal pattern of pain location, and increased pain with coughing, sneezing, and straining.

The patient in this case report did not clearly fit into a nerve root classification. Although his finger-to-floor distance was severely limited, this physical examination finding may also be associated with nonspecific LBP, which was his initial classification.

**Diagnosis of CES**

CES often has a rapid clinical progression from other forms of LBP, which makes timely diagnosis extremely important. CES must be included in the differential

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**Table 3**

**Diagnostic Test Properties for Tests of Nerve Root Dysfunction**

<table>
<thead>
<tr>
<th>Test of Nerve Root Dysfunction</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of sciatica</td>
<td>0.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower extremity pain greater than back pain</td>
<td>0.82</td>
<td>0.54</td>
<td>1.74</td>
<td>0.33</td>
</tr>
<tr>
<td>Dermatomal distribution of pain</td>
<td>0.89</td>
<td>0.31</td>
<td>1.3</td>
<td>0.34</td>
</tr>
</tbody>
</table>

**Table 4**

**Differential Diagnosis of Low Back Pain (LBP) With Potential Neurologic Involvement**

<table>
<thead>
<tr>
<th>LBP Category</th>
<th>Radiculopathy From Acute Disc Herniation</th>
<th>Spinal Stenosis</th>
<th>Cauda Equina Syndrome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>30-55</td>
<td>&gt;60</td>
<td>40-60</td>
</tr>
<tr>
<td>History</td>
<td>Acute or recurrent episodes</td>
<td>Insidious onset of chronic, progressive LBP; more recent onset of lower extremity symptoms</td>
<td>Insidious onset of severe LBP with or without saddle anesthesia, bowel/bladder function changes, possible history of chronic LBP</td>
</tr>
<tr>
<td>Pain pattern</td>
<td>Pain and/or numbness radiating to 1 lower extremity below the knee, usually increased with lumbar flexion</td>
<td>Lower extremity symptoms increased with lumbar extension, relieved by lumbar flexion</td>
<td>Usually presents with radiating pain and numbness/tingling in both lower extremities, increased with lumbar flexion</td>
</tr>
<tr>
<td>Neurological exam</td>
<td>Sensory and/or motor changes, diminished/absent deep tendon reflexes unilaterally</td>
<td>Sensory and motor changes</td>
<td>Bilateral sensory and/or motor changes, diminished/absent deep tendon reflexes, sensory and motor changes at S3-4 levels</td>
</tr>
<tr>
<td>Range of motion</td>
<td>Guarded, limited</td>
<td>Pain and limited extension</td>
<td>Guarded, limited</td>
</tr>
<tr>
<td>Other tests</td>
<td>Straight-leg raise</td>
<td>Stage treadmill test</td>
<td>Straight-leg raise</td>
</tr>
</tbody>
</table>
diagnosis for patients presenting with LBP with or without signs/symptoms of nerve root compression,45 and the patient history should include special questions that attempt to identify patients with serious spinal pathology. TABLE 4 describes common subjective and objective findings useful for the differential diagnosis of possible neural involvement. Approximately 30% of patients present with CES as the first manifestation of lumbar disc herniation.1,44 More often, however, patients will present with chronic LBP that progresses rapidly to CES within 24 hours.43 Over a 10-day period of general worsening but neurologic stability, the patient in this case rapidly progressed over 24 hours from a history without any red flag symptoms to all of the red flags associated with CES, including difficulty with micturition, loss of anal sphincter tone, saddle anesthesia, and severely impaired gait.

The physical examination to identify CES must include assessment of the L1 to S3-4 levels, including anal sphincter tone (S3-4), perianal sensation (S3-4), the anal wink reflex (S3-4), and the cremasteric reflex (L1-2) (TABLE 5). The most frequent physical exam finding is urinary retention.11,15,23,45 A residual volume greater than 100 to 200 cc is considered positive for urinary retention.45 Decreased anal sphincter tone is present in 60% to 80% of individuals with CES.15,45

Patients who present with severe or progressive neurologic deficits should have a prompt imaging work-up, with MRI (preferred) or CT.11 While the advanced diagnostic imaging was delayed in this case due to lack of availability, the CT images demonstrating the patient’s midline herniation at the L4-5 level were consistent with the most common location and type of disc herniation associated with CES.11,15

Referral and Treatment of CES

The primary indicators for neurosurgical referral for this patient were the presence of bowel and bladder function changes, saddle anesthesia, decreased anal sphincter tone, and progressive neurological changes (new onset of significant motor weakness in the S1 myotome).

CES is the primary absolute indication for acute surgical treatment of lumbar spine pathology.3 Rapid recognition coupled with timely referral and surgical care provides the best chance of functional recovery.45 The treatment of choice is surgical decompression, usually a laminectomy followed by discectomy.43,44 Performing the laminectomy first allows excision of the extruded disc material without undue manipulation of the neural elements.43 The patient in this case had an emergent laminectomy and decompression with removal of the extruded disc fragment from the epidural space, confirming the diagnosis of CES. Surgical intervention was performed within 72 hours of diagnosis, which was extremely close to the length of time where the risk of permanent neurologic deficit is increased. Although not optimal, this delay was related to the realities of medical care in a combat environment, and every effort was made to ensure a rapid evacuation of this patient to a neurosurgeon. Even under standard conditions, Shapiro44 previously reported that only 45% of patients presenting to the emergency room or primary care physician underwent surgery within 72 hours of diagnosis.

Following surgery, the patient had limited inpatient physical therapy and was later placed on a convalescent leave status for 30 days. He was released with instructions to complete a progressive walking program and given activity restrictions consistent with discharge instructions for patients receiving lumbar spine discectomy surgery. The patient was not referred to outpatient physical therapy services as part of his rehabilitation, possibly due to his rapid symptom recovery, high level of motivation to return to full function, and ability to carefully progress on a general home exercise program. Although this patient did not receive postoperative outpatient physical therapy, there is strong evidence to support intensive exercise training beginning 4 to 6 weeks after nonfusion lumbar spine surgery,13,16,37 which focuses on trunk/pelvis and lower extremity strengthening,13,29,37 cardiovascular conditioning,41 and stretching of the lumbopelvic musculature.41

**TABLE 5**

<table>
<thead>
<tr>
<th>Test for Cauda Equina Syndrome</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+LR</th>
<th>–LR</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary retention</td>
<td>0.9</td>
<td>0.95</td>
<td>18</td>
<td>0.01</td>
<td>Chou, Deyo, Haswell, Small</td>
</tr>
<tr>
<td>Unilateral or bilateral sciatica</td>
<td>&gt;0.80</td>
<td></td>
<td></td>
<td></td>
<td>Deyo, Haswell</td>
</tr>
<tr>
<td>Unilateral or bilateral motor/sensory deficits</td>
<td>&gt;0.80</td>
<td></td>
<td></td>
<td></td>
<td>Deyo, Haswell</td>
</tr>
<tr>
<td>Positive straight-leg raise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory deficit: buttocks, posterior-superior thigh, perianal region</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abbreviations: +LR, positive likelihood ratio; –LR, negative likelihood ratio.</td>
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</tr>
</tbody>
</table>

**Prognosis of CES**

At his 18-week follow-up appointment, the patient had an excellent result, with no motor deficits, normal bowel and bladder function, and return to full occupational duties. The excellent outcome in this case highlights the importance of early recognition of symptoms and immediate surgical referral.

Recent research has shown a significant advantage to treatment within 48 hours of onset.14 The risk of permanent neurologic deficits is increased when more than 72 hours elapses before definitive treatment and longer delays correlate with worsening functional outcomes.8 In a meta-analysis of surgical outcomes of CES, 3 factors suggestive...
of a poor outcome were identified: history of chronic LBP, preoperative rectal dysfunction (diminished motor or sensor function), and surgical intervention greater than 48 hours after onset of CES. The patient in our case clearly recovered better than expected, considering that all 3 of the items suggestive of a poor prognosis were present.

Attaching a numerical value to the prognosis for patients with CES is difficult. A common problem in current research is the limited number of patients studied, secondary to the rarity of the disorder. Subsequently, studies of CES often have limited power to detect significant differences in prognosis. Physical Therapy Direct Access

During deployment in support of combat operations, military physical therapists provide direct access and primary care for injured soldiers. The case of CES presented here, however, is not necessarily unique to the military or combat environment and a very similar presentation could be seen in any clinic with or without direct access. Recent research has shown that direct access to physical therapy services does not compromise patient safety. Physical therapists have proven themselves able to identify serious pathology that mimics a musculoskeletal complaint and possess diagnostic accuracy equivalent to orthopaedic surgeons.

CONCLUSION

Physical therapists must continually monitor patient status and act appropriately when conditions emerge that require immediate referral. Physical therapists often treat a high volume of patients with LBP, the majority of which are nonspecific and benign in nature. Although CES is a rare disorder, the potential devastating consequences of a missed diagnosis make a thorough evaluation and continuous medical screening throughout the patient management cycle essential. The current case problem describes a unique episode of nonspecific LBP with rapid progression to CES during ongoing management, and correct diagnosis and referral by a physical therapist in a direct-access setting. Timely referral and surgical intervention in this case was associated with an excellent outcome and full functional recovery.

REFERENCES


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