

# Misdiagnosed hamstring strain injury: a case report of early cauda equina syndrome

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**Objective:** *This case report discusses the diagnostic challenges associated with the early identification of cauda equina syndrome in a 25-year-old patient without lumbar spinal pain. It introduces a new classification scheme related to a more effective diagnosis.*

**Clinical features:** *The patient experienced pain in the right hamstring, diagnosed as a pulled muscle. Later, he experienced new symptoms of testicular pain and bladder issues.*

**Intervention and outcomes:** *Chiropractic treatments alleviated his right hamstring pain, albeit temporarily. Subsequently, new symptoms emerged, prompting the patient's referral to a local hospital. An MRI examination revealed a large lumbar disc herniation, leading to a microdiscectomy.*

**“Présentation d’un syndrome précoce de la queue de cheval imitant une élongation musculaire de l’ischio-jambier: un rapport de cas”**

**Objectifs:** *Ce rapport de cas aborde les défis de diagnostic associés à l’identification précoce du syndrome de la queue de cheval chez un patient de 25 ans sans douleur lombaire. Il introduit un nouveau schéma de classification lié à un diagnostic plus efficace.*

**Caractéristiques cliniques:** *Le patient a ressenti une douleur au muscle ischiojambier droit, diagnostiquée comme une élongation musculaire. Plus tard, il a ressenti de nouveaux symptômes de douleur testiculaire et de problèmes de vessie.*

**Intervention et résultats:** *Les traitements chiropratiques ont soulagé sa douleur au muscle ischiojambier droit, bien que temporairement. Par la suite, de nouveaux symptômes sont apparus, ce qui a conduit à l’orientation du patient vers un hôpital local. Une IRM a révélé une importante hernie discale lombaire, ce qui a nécessité une microdiscectomie.*

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*Summary: The reader will learn about a new classification of five different levels of CES. This classification is an important tool in clinical practice. This article also reviews critical information about the mixed neurological presentations of cauda equina syndrome, helping practitioners better understand these important clinical variants.*

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KEY WORDS: chiropractic, cauda equina syndrome, diagnosis

*Résumé: Le lecteur apprendra une nouvelle classification de cinq niveaux différents du syndrome de la queue de cheval. Cette classification est un outil important dans la pratique clinique. Cet article passe également en revue des renseignements essentiels sur les présentations neurologiques mixtes du syndrome de la queue de cheval, aidant ainsi les praticiens à mieux comprendre ces importantes variantes cliniques.*

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MOTS CLÉS : chiropratique, syndrome de la queue de cheval, diagnostic

## Introduction

Cauda equina syndrome (CES) is a constellation of symptoms that primarily involves bladder and bowel dysfunction. Patients typically experience symptoms such as low back pain with unilateral or bilateral sciatica, fecal incontinence, bladder dysfunction, reduced sexual function, leg muscle weakness, and loss of sensation in the perineum, buttocks, and upper posterior thighs.<sup>1</sup> Historically, CES referred to the compression of the nerve roots below S1, especially S2, S3, S4 and S5.<sup>2</sup> In the literature, CES is a term associated anatomically and clinically with compression of the lumbar, sacral, and coccygeal nerve roots distal to the end of the conus medullaris.<sup>3</sup>

The primary cause of CES is lumbar disc herniation (LDH), and CES accounts for approximately 1-3% of LDH presentations. There are numerous other causes, such as spinal fractures, vascular lesions of the spinal canal, and complications from spinal anesthesia.<sup>1</sup> Regardless of the cause of CES, if symptoms appear abruptly, surgical decompression is required within 48 hours. After this time, there is an increased risk of permanent bowel, bladder, and sexual dysfunctions.<sup>1</sup> Therefore, early diagnosis is crucial to avoid the risk of such complications and potential litigation against the treating practitioner.<sup>2</sup>

CES has been reported as a rare complication of spinal manipulative therapy (SMT).<sup>5</sup> Between 2000 and 2011, six court decisions involving Canadian chiropractors allegedly causing CES following SMT were published.<sup>5</sup> Due to the wide range of clinical presentations of CES, the authors believe that early diagnosis of CES can eas-

ily be missed or delayed. The following case report of a young man presenting without low back pain illustrates the diagnostic challenge for a case of a lumbar disc herniation associated with early clinical symptoms of CES. The proposed classification scheme for CES is intended to help practitioners improve their diagnosis accuracy.

## Case report

A 25-year-old university student visited a Student Out-patient Chiropractic Clinic complaining of a gradual onset of pain in the posterior right thigh for the past few weeks. He did not have any known cause for this pain and denied experiencing any lower back pain or symptoms below his right knee. He described the pain as a tight, painful sensation in his hamstring, worse in the morning and at the end of the day. The pain was exacerbated during his part-time job as a waiter in a restaurant, and when lying down on his back with his right leg straight. He experienced some relief by taking NSAIDs daily. The student was otherwise in good health and regularly engaged in weightlifting, boxing, and jogging.

The initial examination did not reveal any antalgic posture or gait disturbances. Lumbar spine range of motion was full and pain-free, except for some discomfort at the end range of flexion due to tightness of the hamstrings. Palpation of the right hamstrings (biceps femoris and semitendinosus) revealed increased muscle tension and pain. Motion palpation of the lumbar spine revealed joint restriction at the level of the L4-L5 vertebral segment in the left rotation plane. The straight leg raise test

was 70 degrees bilaterally without any signs of nerve root tension. The neurological examination did not show any significant findings, except for brisk and symmetrical deep patellar tendon reflexes (3+). Ankle clonus was not present and plantar response was down going. He was diagnosed with a possible right hamstring strain, likely from his gym workouts. Over four months, he received 12 chiropractic treatments, consisting of three separate sets of four treatments each.

The patient experienced a 95% improvement of his hamstring pain after undergoing the first four chiropractic treatments. These treatments included deep soft tissue therapy (without instrument-assisted soft tissue mobilization technique) targeting the right hamstrings, gluteal muscles, and iliopsoas. The patient was also treated with diversified SMT to address the lumbar spine and right SI-joint hypomobility. High-velocity low amplitude spinal manipulations were provided at the level of L4-L5 vertebral segment with the patient lying on his left side. He was given a home program of stretching exercises for his tight hamstrings.

A month after his first visit, he returned to the Clinic as he was experiencing increased pain in his right posterior thigh, which he attributed to playing volleyball and tennis in the past few days. He underwent another course of chiropractic treatments with the same intern and supervising clinicians, who provided the same treatment as before, once a week for four weeks. However, each treatment only offered temporary relief.

Two weeks later, the patient revisited the Clinic complaining of severe, constant pain in his right posterior thigh, with an intensity ranging from 2 to 8 out of 10. The pain in his thigh was affecting his ability to sit and walk for more than an hour. NSAIDs helped relieve his thigh pain. He mentioned that he still did not have any lumbar pain, but he reported a new symptom of intermittent electrical-like pain in his right testicle, especially when sitting for prolonged periods. Unfortunately, the new testicular symptom was not investigated.

During the physical examination, he was now limping on the right side and had difficulty extending his right knee due to posterior thigh pain. When asked about coughing, sneezing, and bearing down during bowel movement (Dejerine's triad), he reported experiencing pain in the right thigh. Valsalva's manoeuvre was negative. Neurological examination of the lower extremities did not re-

veal any weaknesses (5/5), and the deep patellar tendon reflexes were brisk but symmetrical at 4+, and the Achilles tendon reflexes were graded at 2+ bilaterally. Sensory examination of the lower extremities showed a slight decrease in light touch over the lateral aspect of the right foot (S1). Ankle clonus was absent and plantar responses were down-going. Straight leg raise was approximately 60 degrees bilaterally without nerve root tension signs. His treatment regimen remained the same as before, consisting of deep soft tissue therapy and SMT directed at the L4-L5 vertebral segment, which provided immediate relief of his posterior thigh pain.

He returned four days later reporting that his right posterior thigh pain had flared up again a couple of days after his last treatment. However, he mentioned that his right testicular pain had improved by 40%. He was able to lie down on his stomach and on his back without any discomfort. He was taking Naproxen® and cyclobenzaprine®, which he had recently been prescribed by his GP.

A few days later, his condition worsened. He still denied having any lumbar spinal pain. When standing upright, his right leg could not be raised passively (standing SLR) more than 30 degrees, causing severe right posterior thigh pain. He received electrotherapy (TENS) for the right leg, but no SMT to the lumbar spine. After the treatment, he reported no significant improvement. Radiographs of the lumbar spine were recommended to rule out a spondylolisthesis, but he chose to wait to discuss it with his GP.

He returned five days later, stating that his last treatment only provided temporary relief. Further investigation of his right hamstring and right sacroiliac joint was difficult as he was now experiencing too much posterior thigh pain to lie down in the prone position. Palpation of the lumbar spine was unremarkable for muscle spasms or local articular dysfunction. He was questioned regarding bowel and bladder functions, which the patient found strange and unrelated to his condition. He did, however, state that he had trouble emptying his bladder for the past three days. Repeated neurological examination remained unremarkable for pathological reflexes and motor power loss in the lower extremities. Deep tendon reflexes revealed a diminished right Achilles tendon reflex at 1+ versus 2+ on the left. There was a sensory deficit to a painful stimulus over the posterior right thigh. Valsalva's manoeuvre remained unremarkable. Other special manoeuvres

res, such as anal tone, cremasteric and bulbocavernosus reflexes, were not performed.

On that day, plain film radiographs of the lumbar spine were taken and reported by a radiologist. The report indicated joint space narrowing at L5-S1 and a small osteophyte posterior to L5-S1. The rest of the study was normal (Figures 1a, 1b).



Figure 1a.

*Lumbar spine plain film radiograph (Anterior-Posterior view).*



Figure 1b.

*Lumbar spine plain film radiograph (lateral view).*

Despite not experiencing low back pain, the patient recently developed urinary retention and persistent right-sided leg symptoms, indicating a high risk of a lumbar disc herniation associated with early symptoms of CES. As a result, the patient was promptly referred for urgent care at the local hospital. Following an investigation, including an MRI of the lumbar spine, a large right paracentral disc herniation at L5-S1 was identified. This herniation compressed the right S1 nerve root, causing central canal stenosis and displacing the roots of the cauda equina towards the left (Figures 2a, 2b). Consequently, the patient was admitted on the same day and underwent a microdiscectomy at the L5-S1 level the following morning.

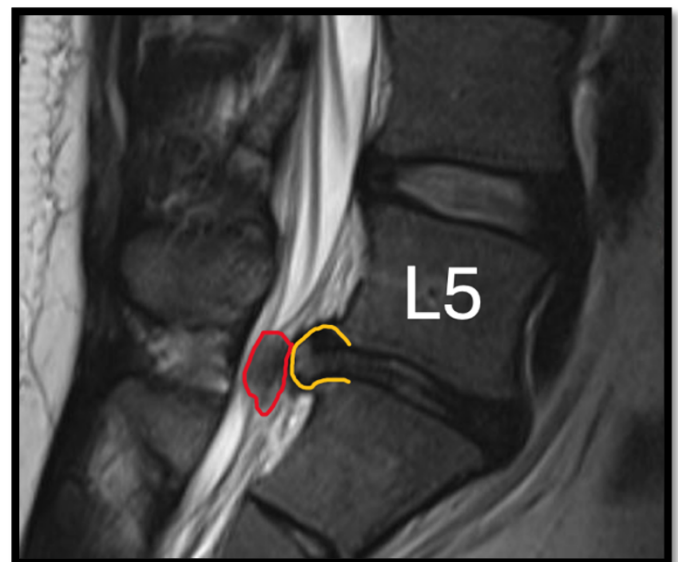


Figure 2a.

*MRI T2-weighted sagittal view of L5-S1 disc herniation. In red, fragment of extruded disc.*



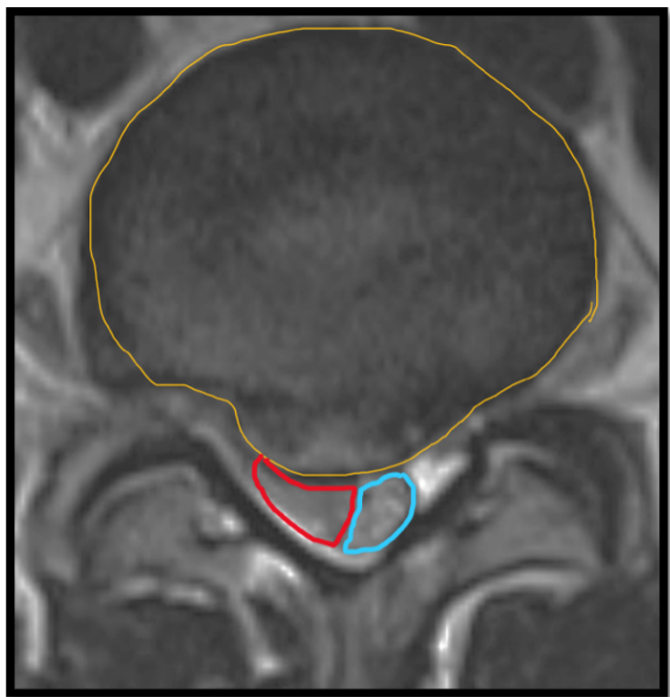


Figure 2b.

MRI T2-weighted axial view of the L5-S1 disc herniation resulting in central canal stenosis while displacing the roots (blue) of the cauda equina. In red fragment of extruded disc.

Eight months after the surgery, the patient was doing well. His urinary function had fully recovered. Although the right posterior thigh pain had initially gone away after the surgery, it returned temporarily six weeks later when he tried jogging for 30 minutes. He has since switched to swimming and cycling. Apart from the persistent brisk patellar deep tendon reflexes (4+), the remaining neurological examination was normal, including symmetrical patellar reflexes at 4+ and Achilles tendon reflexes at 2+. Straight leg raise remained restricted to about 50 degrees bilaterally, but there were no nerve root tension signs. Overall, he was satisfied with the results of the surgery.

### Discussion

The cauda equina is made up of all the lumbar and sacral nerves that emerge from the spinal cord and travel in the spinal canal below the level of the conus medullaris (Figure 3). When the conus medullaris is compressed at the level of the L1-L2 vertebral segment, it can cause clin-

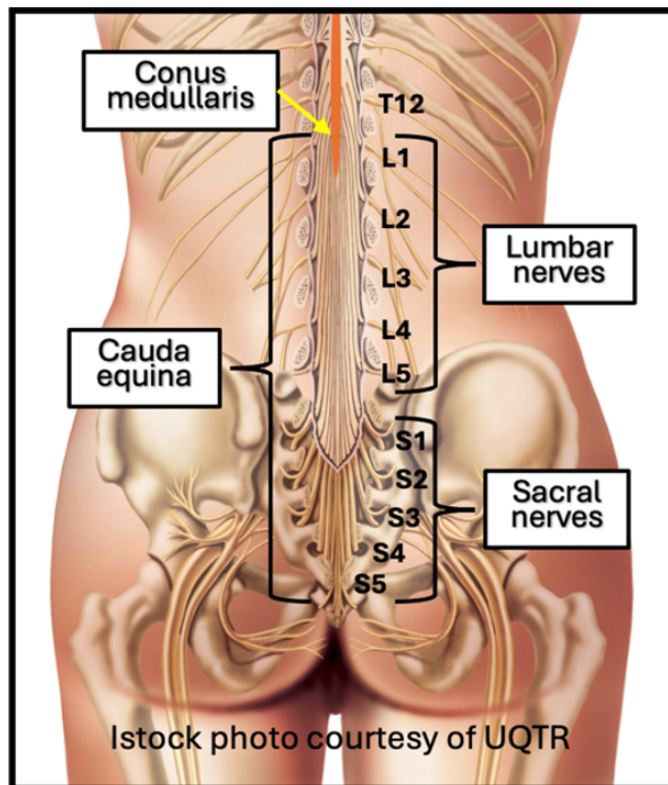


Figure 3.

Illustration of the cauda equina consisting of the lumbar and sacral nerves. Conus medullaris is located at the end of the spinal cord (Istock photo courtesy of UQTR).

ical signs and symptoms similar to CES. In these cases, patients may have a combination of CES symptoms and concomitant compression of the conus medullaris.

The clinical conditions known as “cauda equina syndrome (CES) and conus medullaris syndrome (CMS)” are both rare and are often discussed together when it comes to their epidemiology. Depending on the site of compression, the clinical signs and symptoms can involve upper motor neurons, affecting the sacral segments only in the case of compression of the conus medullaris, and lower motor neurons when involving CES.

### CES classification scheme: a clinical tool

CES can occur suddenly or over a long period. In both cases, individuals may experience severe back pain (83%) and radiculopathy (90%), along with sphincter and perineal symptoms, which are considered the hallmarks of CES.<sup>6</sup> According to Fuso *et al.*'s<sup>7</sup> epidemiological study,

there is a significant time delay ranging from two to 90 days (median time =  $11 \pm 24$  days) between the onset of the symptoms and the final diagnosis of CES.

In acute CES, back pain increases severely and suddenly. There are sensory changes in a dermatomal distribution, as well as motor weakness and possible urinary retention, resulting in overflow incontinence and the need for catheterization. In chronic cases of CES, there is typically recurring and gradually increasing back pain with unilateral or bilateral sensory or motor loss. This is accompanied by gradual bowel and bladder dysfunction over several days to weeks.<sup>1</sup>

In a retrospective study of 32 CES cases, researchers aimed to identify potential reasons for the surgical treatment delays of CES. They found that misdiagnoses and lack of loss of bladder and bowel dysfunction were the most common factors.<sup>8</sup> The study also reported some physician-related factors, including CES not being considered, referral to an inappropriate specialty, inappropriate initial management, and inappropriate advice from the neurosurgical or orthopedic team. Additionally, the study

stated that delays were more likely when fewer clinical features of CES were established at the time of presentation.

Consequently, to reduce delays in diagnosing CES, Lavy *et al.*<sup>2</sup> have recently proposed a comprehensive classification of five different levels of severity based on the presenting signs and symptoms of CES (Table 1). The first level, known as “suspected” cauda equina syndrome (CESS), involves subtle neurological presentations such as bilateral sciatica and motor or sensory loss in the legs, without bladder, bowel, genital, or perineal symptoms. The second level, “early” cauda equina syndrome (CESE), includes normal bladder and bowel functions with some changes in micturition frequency, as seen in our patient’s symptoms. In cases of “intermittent” type of cauda equina syndrome (CESI), patients experience motor and sensory changes, such as saddle anesthesia, without having full retention or incontinence of the bowel or bladder. Instead, they may exhibit neurogenic visceral changes, such as using abdominal compression to assist in voiding, loss of urgency, and alteration of the urinary sensorium.<sup>9</sup>

Table 1.  
Table of comprehensive classification of cauda equina syndrome from Lavy *et al.*<sup>2</sup>

Severity/Progression of CES	Category	Cauda Equina Syndrome (CES) SIGNS & SYMPTOMS
<b>Suspected clinically or radiological (earliest scenario)</b>	<b>CESS</b>	<b>CESS = Cauda Equina Syndrome Suspected</b> Clinical CESS: No bladder/bowel/genital/perineal symptoms, but bilateral sciatica or motor/sensory loss in legs. Radiological CESS: known large disc herniation on MRI.
<b>Early</b>	<b>CESE</b>	<b>CESE = Cauda Equina Syndrome Early</b> Normal bladder, bowel, and sexual function, but some sensory loss in perineum or change in micturition frequency.
<b>Intermittent</b>	<b>CESI</b>	<b>CESI = Cauda Equina Syndrome Intermittent</b> Alteration in bladder/urethral sensation or function, but maintenance of executive bladder control +/- perineal sensory changes, or sexual or bowel sensory or functional changes.
<b>Retention</b>	<b>CESR</b>	<b>CESR = Cauda Equina Syndrome Retention</b> As in CESI, but with painless bladder retention and overflow.
<b>Complete (worst scenario)</b>	<b>CESC</b>	<b>CESC = Cauda Equina Syndrome Complete</b> Insensate bladder with overflow incontinence, no perineal perianal or sexual sensation, no anal tone.

The last two types of CES are what most practitioners recognize as typical signs of CES: “retention” cauda equina syndrome (CESR) and “complete” cauda equina syndrome (CESC). In CESR, patients have developed true urinary retention. Due to the loss of the visceral neurological signal to the central nervous system, they may experience painless urinary retention and eventually overflow incontinence. They may also experience retention or incontinence of the bowel.<sup>6</sup> CESC is a complete full-blown sphincter dysfunction with overflow incontinence, no perineal, or sexual sensation or anal tone.

#### Clinical presentation of CES

The clinical evaluation begins with pertinent screening questions about changes in bladder functions, such as frequency of voiding, difficulty initiating a stream of urine, the ability to suppress the urge to void, presence or absence of urinary incontinence, and loss of bowel control. In addition, related questions cover any changes or loss of feeling in the perineal or genital region, as well as loss of erection or ejaculation in males.<sup>4</sup>

Patients can have a plethora of additional symptoms, and the results of the physical examination can vary greatly.<sup>10</sup> This can be due to differences between patients in the level of spinal compression, lateral shift of the cauda equina, and severity of nerve compression

throughout the cauda equina, as well as the potential compression of the conus medullaris at the L1-L2 level. As a result, lower motor neuron signs are usually more prominent with CES, while upper motor neuron signs can be present when there is compression of the conus medullaris (Table 2).

This case report shows an atypical presentation of LDH, where the patient experienced gradual posterior thigh pain, without lumbar pain. As described by Dr. Erwin, a chiropractor and molecular scientist, the distortion or pressure on the annulus fibrosus by herniated fragments activates mechanoreceptors and nociceptors within the annulus and posterior longitudinal ligament. This activation can lead to reflexive muscular activity, causing muscle spasms and low back pain typically seen in LDH.<sup>11</sup> However, nearly 20% of CES<sup>6</sup> patients do not experience low back pain. Our patient did not have any low back pain, most likely due to initial dominant spinal compression of the ipsilateral S2 nerve root, which also corresponds with his reported onset of neuropathic electrical-like testicular pain (Figure 4). Neuropathic testicular pain is typically caused by a lesion in the nervous system, located away from the area affected by the pain, such as the central or peripheral nervous system.<sup>12</sup> Therefore, the emergence of testicular pain followed by bladder symptoms several weeks later strongly suggests the diagnosis of CES and requires prompt medical referral.

Table 2.

*Adapted from Dawodu ST, Cauda Equina and Conus Medullaris Syndromes, Medscape, Jun 14, 2018.<sup>10</sup>*

	<b>CONUS MEDULLARIS SYNDROME (Upper Motor Neuron Lesion)</b>	<b>CAUDA EQUINA SYNDROME (Lower Motor Neuron Lesion)</b>
<b>Onset</b>	Sudden & bilateral leg symptoms	Gradual & unilateral leg symptoms
<b>LBP</b>	Acute	Less acute
<b>Sciatica</b>	Less severe	More severe
<b>DTR</b>	Increased	Decreased
<b>Sensory</b>	Saddle anesthesia is symmetrical. Loss of sensation in both legs.	Saddle anesthesia is unilateral. Loss of sensation in one leg.
<b>Plantar response</b>	Present	Absent
<b>Sphincters</b>	Early dysfunction	Late dysfunction

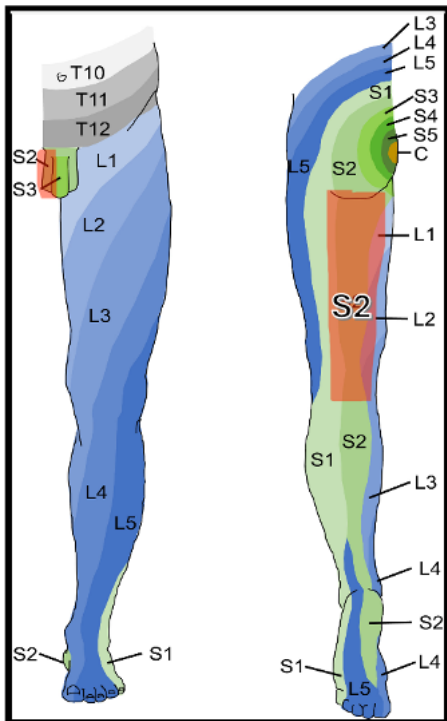


Figure 4.

Patient's areas of pain affecting the posterior thigh and testicle (orange). Adopted from Ostelo, R. W. *Physiotherapy management of sciatica. J Physiother*, 2020;66;83-88.<sup>13</sup>

### Diagnostic evaluation of CES

The diagnosis of CES is often based on urinary dysfunction, as urinary excretion typically occurs more frequently than bowel excretion. However, a rectal evaluation may also show an absent rectal tone or an inability to voluntarily constrict, which further supports the diagnosis of CES.<sup>6</sup> Bladder studies can help identify urinary dysfunction in cases of CES, but their effectiveness as both diagnostic and prognostic tools has not been definitively established. Normally, values of more than 100 mL post-void residual bladder volume should raise suspicion of urinary retention.<sup>6</sup>

Plain film radiographs are typically the initial imaging study for patients with spine-related complaints. However, they hold little value in evaluating patients suspected of having CES. MRI is the preferred imaging modality in such cases. If an MRI cannot be obtained promptly or if the patient's condition prohibits the use of magnetic resonance imaging (due to non-compatible

hardware or claustrophobia), a CT scan should be performed instead.

### Summary

Early symptoms and signs of CES can be challenging to diagnose. The presented case report highlights one of the many early presentations of the syndrome. When a patient presents with any leg symptoms, it is important to inquire about any changes in bowel and bladder function. In most cases of early cauda equina syndrome (CESE), there are subtle changes in urinary sensation, flow, and frequency before incontinence becomes apparent.<sup>2</sup> These changes should be taken as warning signs for CES. In this case, the patient reported feeling the need to urinate, but only a small amount or nothing would come out. Based on this relevant clinical symptom, it was important to refer the patient to the local hospital, which turned out to be the right medical decision. The patient received timely spinal surgical decompression, leading to a positive outcome.

The proposed comprehensive classification based on the severity of the presenting clinical signs and symptoms shows that CES is not simply an all-or-none clinical condition, but rather a continuum with variations in severity at onset and speed of progression.<sup>2</sup> The proposed classification of CES might help practitioners minimize the risk of misdiagnosing CES.

Additionally, practitioners need to recognize that patients with symptoms of CES may also exhibit signs of conus medullaris involvement, such as pathological reflexes. Regardless of where the spinal compression is located, CES is a serious condition that requires urgent surgical decompression to prevent permanent sphincter, motor, and sensory deficits.

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