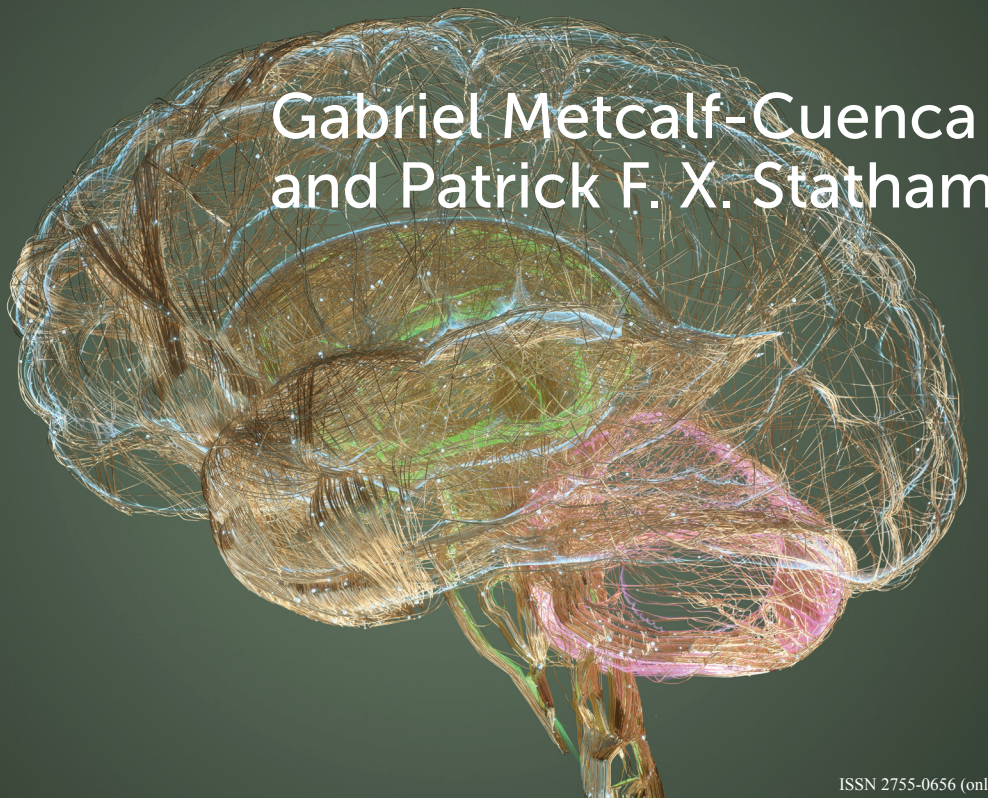
Cambridge Elements

Emergency Neurosurgery

Patient with Suspected Cauda Equina Syndrome

Gabriel Metcalf-Cuenca and Patrick F. X. Statham



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PATIENT WITH SUSPECTED CAUDA EQUINA SYNDROME

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Patient with Suspected Cauda Equina Syndrome

Elements in Emergency Neurosurgery

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Abstract: Cauda equina syndrome is the clinical syndrome seen when there is acute compression of the cauda equina nerve roots and is a rare neurosurgical emergency. The approximate incidence in patients presenting with low back pain is 0.27 per cent but delays in investigation and treatment can result in life-changing permanent disability. The best practice for patients presenting with potential cauda equina syndrome is urgent MRI imaging at the presenting hospital to avoid delays in diagnosis. Patients with a positive finding of cauda equina compression should proceed to decompressive surgery to restore the diameter of the spinal canal urgently to reduce the risk of developing a permanent deficit.

Keywords: CES, cauda equina syndrome, emergency MRI, emergency decompression, CES guidance

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Contents

Cauda equina syndrome (CES) is the clinical syndrome produced by acute compression of the cauda equina nerve roots and is a rare neurosurgical emergency. Delays in investigation or treatment for CES can result in life-changing disability for the patient and subsequently career-changing litigation for the clinician. Lower limb radiculopathy and back pain are the most common presenting symptoms of spinal disease and make up a significant proportion of emergency referrals to neurosurgery. Identifying which of these cases represent possible acute cauda equina compression and therefore which patients require emergency imaging is an important skill for every neurosurgeon.

Background

The pathological basis of CES is compression of the cauda equina nerve roots within the lumbar spinal canal secondary to any acute pathology. Across the UK the most common cause in young people is a large central intervertebral disc prolapse but traumatic fractures, epidural abscesses and vertebral body metastatic lesions are important other causes of cauda equina compression. The rest of this Element will be referring to a large acute intervertebral disc prolapse where CES is mentioned as this is the most common cause and other pathologies will be dealt with elsewhere.

Although CES is a rare condition with an estimated incidence in patients presenting with low-back pain to secondary care of 0.27 per cent,[1] the symptoms and signs suggestive of the condition are much more common. An average clinician in the emergency department will therefore only see one case of CES for every 370 patients presenting with low back pain. Missing the early diagnosis can potentially cause long-term severe disability so the use of urgent MRI imaging to confirm the presence of an acute disc prolapse is essential.

The diagnosis of CES is made based on both clinical evidence of cauda equina root dysfunction and radiological evidence of cauda equina compression. There have been several previous definitions of CES and classifications of CES based on clinical features or radiological findings aiming to organise presentations into groups for prognosis or methods of treatment.[2],[3] We will follow the classification by Hoeritzauer et al.[3] throughout this Element of 'scan-positive' CES in cases where the patient has symptoms and radiological imaging has confirmed cauda equina compression and 'scan-negative' CES where radiological imaging does not show compression of the entire cauda equina.

Animal studies and laboratory work indicate that the cauda equina nerve roots are highly sensitive to compressive pressure and there is a direct relationship between intra-spinal pressure and nerve root dysfunction.[4] However, with sustained high intra-spinal pressures or with intra-spinal pressures above the systolic blood pressure, there is more likely to be irreversible cauda equina nerve root

damage with little recovery in symptoms following decompression surgery. The underlying pathology in these cases is likely ischaemia secondary to sustained high intra-spinal pressure, not only neuronal compression and axonal injury. Therefore, speed in treatment once an early diagnosis is made may contribute to reducing the risk of a permanent deficit developing.

Clinical Presentation

The Understanding CES (UCES) study showed that there are no single or combination of clinical features that are present in all cases of CES.[5] The most common clinical features were back pain or sciatica which were each present in over 90 per cent of cases. Some forms of bladder dysfunction and alterations in saddle sensation were each present in at least 80 per cent of cases. The least common presentation of CES was isolated bilateral sciatica with no bladder/bowel dysfunction and no saddle sensory loss, occurring in only 2 per cent of patients. The overall complication rate following surgery was 26 per cent, indicating a high morbidity associated with surgical intervention for CES. The likely clinical benefit from surgery needs to be clear to balance this risk.

To ensure no potential cases of CES are missed and patients at risk of potential deterioration are identified, all patients presenting with new low back pain or radicular leg pain should be initially assessed for possible CES by the healthcare professional they present to. In practice, this can be done through screening questions for 'red-flag' symptoms that have developed within the preceding two weeks (see Box 1). Any positive answers to the screening questions should prompt further assessment or investigation for potential CES. Although presentations of CES are very variable, a history of back pain or sciatica with no features of cauda equina dysfunction and a normal examination

Box 1 Red-flag features for cauda equina syndrome screening [6]

Red-flag symptoms for CES, newly occurring within the preceding two weeks:

1. Difficulty initiating micturition or altered sensation of urinary stream;
2. Altered perianal, perineal or genital sensation (area of altered sensation may be small or the whole saddle region);
3. Progressive or severe neurological deficit of the lower limbs;
4. Loss of sensation of rectal filling;
5. Sexual dysfunction (including loss of genital sensation (including internal vaginal sensation), inability to achieve or maintain erection and inability to ejaculate).

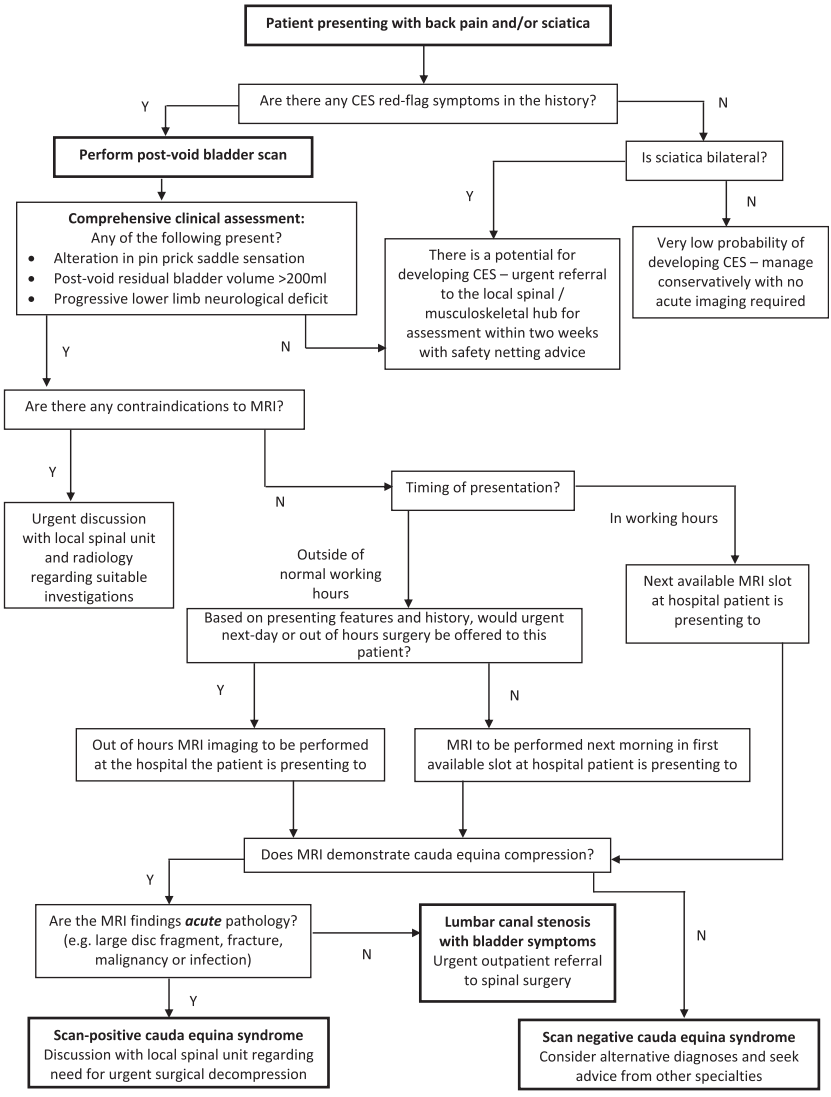
is very unlikely to progress to CES over time and therefore does not need urgent imaging and can be managed conservatively in the community.

It is important to assess patients presenting with potential CES in a holistic way and undertake an assessment of the whole patient. Musculoskeletal low back pain is very common and will affect most people at some point in their lives just as urinary disturbance is a very common symptom and can be due to many pathologies. As CES is a rare condition, the most likely explanation for a patient's symptoms is concurrent unrelated pathologies that need to be investigated. Too often, when patients are labelled as having potential CES, all other differentials are ignored and the patient is then at risk of deterioration from other conditions, such as a urinary tract infection, as emergency spinal imaging becomes the priority. It is therefore important to consider other causes of the patients' symptoms in the differential and Table 1 lists some of the common and important causes of urinary dysfunction, key features in the history to be aware of and diagnostic investigations which can be of use.

Table 1 Common causes of urinary dysfunction and their clinical features and investigations

Cause	Clinical features	Investigation and referral
Benign prostatic enlargement	Chronic onset, difficulty initiating micturition with hesitancy, post-micturition dribbling, poor urinary flow, urinary tenesmus	Prostate examination *Urology referral*
Pelvic floor dysfunction	Chronic onset, previous vaginal birth / pelvic surgery, stress incontinence, no difficulty initiating micturition	Urodynamic studies *Urology / Urogynaecology referral*
Urinary tract infection	Acute onset, dysuria, lower abdominal pain/discomfort, flank pain, generally unwell, pyrexia	Urinary microscopy and culture *Acute Medicine referral if unwell* *Manage in GP if systemically well*
Urinary stone disease	Acute onset, flank or abdominal pain, difficulty initiating micturition, haematuria	Urine dip Non-contrast CT renal tract *Urology referral*
Urinary tract malignancy	Subacute onset, weight loss, haematuria, abdominal discomfort / pain, urinary hesitancy, palpable abdominal or flank mass, urinary tenesmus	Urine dip CT renal tract *Urgent Urology referral*

Algorithm for Assessment and Investigation of Patients Presenting with Symptoms of CES



Acute Cauda Equina Compression

Determining the acuity of the presentation is essential to deciding on the timeline for investigation and treatment. As discussed earlier, a relatively short history of symptom progression is key. Development of red-flag symptoms of cauda equina compression within the preceding two weeks is the

recommended onset in national guidance created by the British Association of Spinal Surgeons (BASS) and the Society of British Neurological Surgeons (SBNS) and in the GIRFT National Suspected Cauda Equina Syndrome Pathway.[6],[7]

Several clinical findings on examination can be helpful in identifying the presence of cauda equina dysfunction, which may not have been obvious from the history or symptomatology. The previous guidance in the UK by Todd and Dickson suggested a clinical examination involving assessment of lower limb neurological function, assessment of saddle sensory change, a digital rectal examination (DRE) for anal tone and assessment of post-void bladder residual volume (PVBV).[8] It is important to bear in mind that the absence of any of these findings on examination does not rule out the presence of radiological cauda equina compression on imaging.

A DRE to assess for anal tone and the presence of voluntary anal contraction has historically been a key part of the assessment of patients with potential CES. Studies have shown that medical professionals are very poor at assessing anal tone and that reduced anal tone is not correlated with MRI findings in CES.[9],[10],[11], As DRE is an invasive and often unpleasant examination for the patient, we do not recommend it as part of the assessment of patients presenting with possible CES. Indeed, Tabrah et al.[10] found in their meta-analysis that there is no other clinical indication for the assessment of anal tone.

Perianal sensation is a far more sensitive test of sacral root function, especially pinprick sensation.[11] Although normal saddle sensation does not rule out the possibility of CES, as 19 per cent of patients in the UCES study had normal saddle sensation at presentation, it does help stratify how urgently patients need imaging.[5] PVBV has previously been shown to be a good predictor of CES with a greater likelihood of CES if PVBV is over 200ml but not all cases of CES have altered bladder voiding.[12],[13], The UCES study showed that a raised PVBV was only present in 41 per cent of those who had bladder scanning performed. Although, it was found that a higher pre-operative PVBV requiring catheterisation was associated with higher rates of post-operative bladder dysfunction.[5] We therefore suggest using perianal sensation and PVBV as part of the assessment to indicate, but not impair, the urgency of scanning and intervention if required.

Chronic Lumbar Stenosis

Although there is evidence that patients with chronic lumbar canal stenosis may develop progressive bladder symptoms from their pathology, there is little risk of this progressing acutely so urgent decompressive surgery is not

often required.[14] The history is key to ascertaining if the underlying pathology is an acute radiculopathy or potential CES as opposed to a picture of neurogenic claudication where symptoms do not occur at rest and worsening is associated with progressive physical activity. Severe lumbar canal stenosis can be managed as an outpatient and does not require urgent admission for assessment.

Another consideration in patients presenting with stenosis is that it generally occurs in an older population with more comorbidities and a higher likelihood of urinary symptoms secondary to other pathology. The most common cause of bladder dysfunction in women is pelvic floor dysfunction resulting in stress incontinence and in men it is prostatic hyperplasia resulting in bladder outlet obstruction. The history and timing of symptom onset is therefore key in identifying if there has been an acute change in condition with new symptoms of cauda equina dysfunction, or an acute worsening of their chronic stenosis with a background of long-standing urinary symptoms. As the population ages, these presentations will become more common and become a greater strain on resources (and a source of anxiety for the patients) if every time there is a change in their symptoms an urgent MRI is required.

Investigation and Guidelines

When clinical assessment has identified a patient with potential cauda equina compression, the key investigation to identify if a patient has a compressive pathology requiring surgery is MRI imaging of the lumbar spine. It is therefore important to identify if the patient has any contraindications to MRI imaging and how absolute these contraindications are. In the cases that MRI imaging cannot be performed (such as due to embedded metallic shrapnel within the patient's body), the only other imaging modality that would be able to definitively identify the presence of cauda equina compression is a CT myelogram. This requires both intrathecal injection of contrast and interpretation by a radiologist experienced in the modality. The risks and relative infrequency of CT myelograms mean they are not available urgently in most centres in the UK and in the absence of MRI suitability there are no definitive diagnostic tests for CES for some patients. CT lumbar spine with soft tissue windows is recommended in these instances by the BASS and SBNS joint guidance and in the GIRFT Pathway.[6],[7]

Historically, many medical devices (such as cardiac pacemakers and surgical clips) were made from materials that are MRI incompatible resulting in patients with these devices being unable to be scanned for symptoms of CES.

However, with developments in medical technology in the past few decades, it is rare for devices or implants to not be MRI safe. Although some district general hospital radiology departments have previously considered all cardiac devices to be a contraindication to MRI, recent guidance indicates that even many older devices can be safely managed during MRI scanning.[15] It is important to clarify exactly what device a patient has and liaise with both the local cardiac physiology department and radiology departments to determine the safety of MRI and procedures which can be performed to mitigate risk. Patients should only be referred without imaging to a spinal centre if there is a true contraindication to MRI.

Hoeritzauer et al.[3] reported a rate of 28 per cent for positive MRI scans in a large tertiary centre, indicating that the majority of MRI scans performed for potential CES will be negative and not require surgical intervention. Given the incidence of back pain and radicular pain in patients presenting to both primary and secondary care, a significant number of patients will require urgent imaging to rule out CES. The recommendations are that patients with a potential diagnosis of CES have urgent MRI imaging of the lumbar spine in the local hospital where the patient has presented with a referral to the regional spinal centre only when cauda equina compression is demonstrated.[6],[7],[16]The guidance suggests that as CES is a time-critical emergency, the scans should be performed in preference to planned routine outpatient MRI scans with a target of 4 hours from the time of request to the MRI being performed. However, there are many factors that can influence the urgency with which the MRI is performed, and a pragmatic interpretation of the guidance is provided in the assessment and investigation algorithm.

MRI imaging is diagnostic and should be undertaken urgently when the results will influence the treatment of the patient. However, in patients who would not be a surgical candidate due to significant comorbidities, a discussion should be had on the utility of urgent MRI scanning in the treatment of the patient. It may not change what treatment the patient receives, and indeed certain patients may be averse to surgical treatment, regardless of the risks of conservative management, in which case urgent MRI imaging may also not change the treatment pathway the patient receives. In these cases, it may be suitable to organise an urgent outpatient MRI. However, in most cases, an urgent MRI in the next available slot is the most appropriate investigation. Following on from the GIRFT report on spinal surgery, the recommendations are that all MRI departments in the UK develop 24/7 availability of MRI to ease the burden on regional spinal centres, however, this has not yet become a reality anywhere in the UK.[16]

Management

The definitive management of CES is surgical decompression of the cauda equina nerve roots. The aim of surgical intervention is to restore the diameter of the spinal canal and reduce compressive pressure on the cauda equina nerve roots. Surgery should therefore be primarily targeted at removing the prolapsed disc material and several techniques have been described for this but the most commonly used in the UK are the standard unilateral lamina fenestration, bilateral fenestrations and midline decompression.

The post-operative recovery of sacral root function is poor with Woodfield et al.[5] showing up to 50 per cent of patients at one year have bladder dysfunction, sexual dysfunction or saddle sensory change. Pre-operative bladder dysfunction requiring catheterisation was found to be a poor prognostic sign for post-operative recovery in bladder function. This has a significant effect on patient's quality of life and prior to surgery, they should be well counselled on the surgery aiming to prevent deterioration rather than fully reverse their symptoms. Early post-operative referral to the continence service and input from clinical psychology are helpful. BASS and SBNS guidance recommends post-operative referral to regional spinal injury services if there is any persisting neurological deficit, including bladder or bowel dysfunction.[7]

Pearls and Pitfalls

- The consent is important given the high rate of morbidity associated with CES surgery (up to 26 per cent) – document the consent process clearly.
- Ensure appropriate positioning with a method to minimise abdominal compression – epidural venous engorgement due to high intra-spinal pressure can result in increased risk of bleeding which can be worsened if there is pressure on the abdomen.
- Record intraoperative radiographic evidence of the level being operated – the frequency of persistent post-operative symptoms and high rates of litigation require clear documentation of the correct operative level.
- The cauda equina nerve roots are very sensitive to further changes in pressure or stretch – the approach should be tailored to the surgeon's preference to ensure retraction on the thecal sac is minimised.
- Higher rates of dural tears and CSF leaks occur in CES surgery than elective discectomies – ensure materials and equipment are available to

(cont.)

the surgeon for repair of a dural tear prior to starting the operation (especially important as the surgery may be performed out of hours).

- Post-operative recovery of function is poor and patients should be counselled on this and referred to continence services and psychology early following surgery.

Scan-Negative Cauda Equina Syndrome

Recent attention has been brought to the cohort of patients that make up most referrals for urgent MRI imaging, those patients with red-flag symptoms of CES but without cauda equina compression on MRI imaging. Hoeritzauer et al.[1] showed that this group of patients could be subdivided into those with normal imaging and those with some radicular compression on MRI but without cauda equina compression.

The management of this group of patients can be very difficult but it is important for the spinal surgeon to be aware of other pathologies that can present with features of CES and both how to rule them out and who to refer patients on to for further treatment. A list of differential diagnoses and important diagnostic tests for each is included in Table 2.

Table 2 Neurological differential diagnosis of scan-negative CES

Diagnosis	**Relevant investigations**
Functional neurological disorder	MRI brain and whole spine Clinical diagnosis by exclusion
Neuroinflammatory disorders	MRI brain and whole spine with contrast Lumbar puncture
Spinal cord or brain lesions	MRI brain and whole spine
Guillain-Barre syndrome	Nerve conduction testing Lumbar puncture
Peripheral neuropathy	Nerve conduction testing Serum electrolyte and nutrient levels

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