

# **MACEP Risk Management Course**

## **Module 7: CNS-Spine**

Andrew Koslow, M.D., J.D.

### **Course Objectives**

- Understand the risk management issues of spine emergencies.
  - Be aware of the factors that identify certain patients as high risk for spine emergencies.
  - Know the pertinent history and physical points to perform and document when a spinal emergency is considered.
  - Understand the utility and limitations of imaging studies in suspected spine emergencies.
  - Understand the importance of prompt treatment and consultation when indicated.
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### **Introduction**

The evaluation of spine-related complaints is a critical risk management area for the emergency medicine provider. A missed or delayed diagnosis often results in severe residual disability or death. This is reflected in the malpractice claims data: of one malpractice insurance carrier's top seven indemnity cases in Emergency Medicine (all of which ended in payments over \$1 million) from 2005-2009, three involved spine emergencies. Spine related claims in general comprise approximately one fifth of all cases that end in payment to a plaintiff. If this were not enough to warrant careful risk management practices, consider that emergent spine conditions are relatively infrequent, and this small fraction of patients must be identified amongst the very large number of patients who present with symptoms, such as back pain, that may relate to spinal pathology.

A thorough and systematic approach to the evaluation is the best way to avoid mismanagement of spine emergencies and subsequent malpractice claims. A history and physical examination that facilitates the identification of patients at increased risk for spine emergencies is fundamental. The history and physical findings must then be appropriately used to effect testing, consultation, and treatment where indicated. Proper documentation of the evaluation is also essential in limiting risk. These elements will be discussed in detail below.

Nearly as important is the mindset that the practitioner brings to the patient encounter. For several reasons bias can contribute to the misdiagnosis of spine emergencies. First, most patients with spine-related complaints that a practitioner has seen during his or her career have had non-emergent causes of their symptoms. Many of these patients have psychiatric diagnoses, history of substance abuse, or chronic pain issues. Also, they are frequently triaged to non-urgent patient care areas, where a provider may have some preconception of the patients seen there as less sick. These biases must be avoided, and a vigilant "worst first" attitude should be maintained, keeping

emergent diagnoses in mind during the evaluation of every patient suspected of having spine-related symptoms.

## History

History-taking is the most important tool for identifying emergent spine conditions. A proper history will elicit any “red flag” elements, which should raise the practitioner’s suspicion for a spinal emergency and possibly trigger testing, consultation, and additional treatment. The right questions must be asked, as patients will frequently not volunteer information that is critical in the detection of emergent spine conditions. Adequate privacy and analgesia may facilitate such history taking. Also, be sure to obtain history from other sources when available, such as nursing notes, emergency medical services reports, family and friends of the patient, and old records, especially for the patient who has impaired communication abilities or is not forthcoming in their responses.

Detailed investigation of the chief complaint in spine emergencies, which is most often back pain, is invaluable. As with other chief complaints, the following elements should be documented: onset, location and radiation, severity and character, history and mechanism of any relevant trauma (even those that may seem minor to the patient), associated symptoms, exacerbating and alleviating factors, as well as changes in any of these over time. Beware of a history of recent minor trauma, however, as many patients that have a serious spine diagnosis will have a recent minor trauma of some sort to which they will ascribe their symptoms. If a spine emergency is considered, be sure to ask specifically about motor and sensory (including “saddle” area) changes, problems with gait, bowel or bladder changes, fever and chills, and unintentional weight loss. Accurate documentation of the onset of neurologic deficits is especially important for risk management purposes, as malpractice claims often allege delays in diagnosis and treatment, but in many cases the claimant’s deficits were actually present for a significant amount of time before presentation.

The provider should specifically inquire, if not offered by the patient, about the following red flags for emergent diagnoses:

- Patients older than 50 years or younger than 18 years (especially less than 5 years) are at increased risk for infectious and cancer-related spine pathology.
- Changes in bowel or bladder function, saddle anesthesia, lower extremity weakness or numbness, or erectile dysfunction may be associated with epidural compression.
- Back pain lasting more than 6 weeks, onset of pain over weeks to months, pain unrelieved by rest or worse at night, or symptoms accompanied by fever, chills, or weight loss also indicate a higher possibility of serious pathology.
- Other red flags include repeat visits for a similar complaint, language barrier or other communication difficulty, intoxication, and distraction due to other symptoms or injuries.

The patient’s past medical history may contain pre-existing conditions that are also red flags, such as cancer and immunocompromised states. Intravenous drug use is such a significant risk factor for spinal abscess and osteomyelitis that the IVDA patient with back pain must have these

diagnoses ruled out. Recent bacterial infection and recent procedures (not only spinal, but others that may cause bacteremia) also elevate the risk of spinal infection.

Although a detailed discussion of non-spinal pathology is beyond the scope of this section, the emergency medicine provider should keep in mind the non-spinal but threatening causes of back pain, especially when symptoms are in the thoracic area, which are frequently misdiagnosed as spine-related problems. These include, but are not limited to, aortic dissection, abdominal aortic aneurysm, pancreatitis, and perforated gastric ulcer.

## Physical Examination

Appropriate physical examination is also an important element in diagnosing emergent spine conditions. This begins with the appropriate setting: the patient should be undressed and in a gown, and they should be in as private an area as possible, so that the practitioner can elicit the best history possible and perform all necessary elements of the physical examination.

Complete vital signs must be done. For example, the presence of fever is a red flag when symptoms are suspected to be spine related. In many cases, vital signs such as temperature are omitted in back pain patients at triage, based on the assumption that the symptoms are caused by a musculoskeletal process. Malpractice claims have centered on this point. In general, it is good risk management practice to address any abnormal vital signs on the chart.

The patient who is not lying still may have a serious diagnosis, as most patients with benign causes of back pain prefer not to exacerbate their symptoms by moving. Although this section focuses on spine emergencies, a patient with this sort of appearance should also raise suspicion for renal calculus, pancreatitis, and aortic pathology. The skin should be inspected for findings such as erythema or other sign of soft tissue infection, evidence of past procedures, and herpes zoster rash. Point tenderness to percussion may indicate inflammation, most commonly fracture or infection.

A targeted but thorough neurologic exam must then be performed. Motor function, sensation, and reflexes should be tested and documented for each relevant spinal level, especially those with lumbar and sacral innervation. Sensory exam should include the saddle area. Rectal tone should be assessed if suspicion exists for epidural compression. Babinski reflexes should also be assessed. Postvoid bladder residual volume should be tested if the patient notes urinary retention or incontinence (which may be due to overflow), or epidural compression is suspected. A postvoid residual over 100 ml suggests compression and warrants urgent investigation. Testing for reflex and bladder dysfunction takes on even greater importance in evaluating the patient with altered mental status or others who cannot cooperate with a standard neurologic exam.

Table 1: Red flags in the history and physical examination.

History	Physical
Age greater than 50 or less than 18	Fever

Fever Weight loss Pain for more than 4-6 weeks Pain unrelieved by rest/recumbency Pain worse at night Thoracic back pain Bowel or bladder dysfunction Recent bacterial infection Recent procedure with possible bacteremia History of IVDA Trauma (even minor in the elderly) History of cancer Immunocompromised state/steroid use Repeat ER visits for similar complaint	Patient does not prefer to lie still Point tenderness over spinous process Motor deficit Saddle anesthesia Decreased rectal tone Postvoid residual bladder volume over 100 ml
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## Testing

Studies are not indicated in the ED when there are no red flags, when the practitioner has no suspicion for an emergent spine condition. Overuse of studies results in harm to patients and adversely affects ED flow, as resources such as MRI are limited, and false positive or misleading results (such as the often-seen herniated lumbar disc which is frequently not the cause of the symptoms) often cause further use of resources, including invasive procedures. When these studies are indicated, however, they must be expedited, ideally by direct communication from the emergency physician to the relevant consultants and/or technicians.

In nontraumatic cases, MRI is generally the study of choice, with sensitivity and specificity over 90% for epidural compression (including disc herniation and malignancy), spinal epidural abscess and osteomyelitis. CT, possibly with myelography, may be substituted for those patients with contraindications to MRI. In the setting of trauma, especially in suspected cervical fracture, CT scanning is generally considered to be superior to MRI. MRI has improved in fracture detection to the point of being nearly equivalent to CT according to some sources, but CT may still be preferred in acute trauma due to greater availability, significantly shorter performance time, fewer contraindications, and its utility for trauma to other systems. Plain films are of little use if infection or compression is suspected: if negative, they are not sensitive enough to make more advanced imaging unnecessary; if suspicious abnormalities are noted, further definition of the area with advanced imaging will usually be required anyway. Spinal imaging in trauma is discussed below.

Like imaging, laboratory testing should not be used unless infection, cancer, or other compression is suspected. An elevated white blood cell count, however, is relatively insensitive even in infectious causes (35-61%). An elevated erythrocyte sedimentation rate is more sensitive than the WBC in infection (76-95%) and is somewhat useful when looking for occult malignancy (sensitivity 78%, specificity 67%). Elevated C-reactive protein is usually present in spinal infection (sensitivity 82-98%). Blood cultures are recommended, as they will identify a causative

organism in a majority of spinal infections. Lumbar puncture is not indicated in suspected abscess.

## Documentation

Poor documentation is the foremost risk management issue for physicians, and is a common theme in spinal emergency cases that end in high payouts. The chart should reflect the important details of the chief complaint and associated symptoms, especially those that involve red flags as discussed above. Documenting pertinent negatives in the history and physical are just as important as pertinent positives when it comes to risk factors for spine emergencies.

In a patient evaluation where the neurologic system is relevant, documenting the neurologic exam merely as “normal” or “non-focal” is not recommended. This type of documentation adds an element of uncertainty as to what exactly was done, and may impair the defense of a malpractice claim. For example, a physician defendant who documents a “normal” exam may later be forced to explain the precise elements of his or her customary neurologic exam at deposition and/or at trial, in an effort to convince the courtroom that the physician is absolutely sure that specific and critically important portions of “routine” exam, took place even though the events occurred years earlier. The practitioner should strive to avoid this predicament, as his or her credibility becomes at risk, and plaintiff’s attorneys will frequently use their skills to exploit the situation. Perform a systematic, thorough neurologic exam, and document the findings (or lack thereof) specifically.

Medical decision making is another area where documentation is frequently lacking. The chart should reflect the reasoning behind the key decisions: risk factor analysis, history and physical findings that raise or lower suspicion for a spine emergency, decision whether to perform testing or not. Remember that should a malpractice claim be made, years have often passed since the original encounter, and the provider’s memory of it will be less reliable and less credible: all that remains is the chart. Therefore, the chart should be made to “tell the story,” and reflect the practitioner’s thought process in a manner that a future reviewer will be able to understand.

## Discharge Instructions

Spine emergencies are frequently not diagnosed at the first ED visit. Factors such as early or non-specific presentation, failure to fully evaluate the patient, or other circumstances may result in patients with an emergent condition being discharged from the ED. Patients whose symptoms may be spine-related should receive written discharge instructions that clearly direct them to return if new or worsening motor or sensory symptoms, bowel or bladder changes, or fever with back pain. The patient should exhibit understanding of the instructions (with language barriers, etc. having been addressed) and sign the hospital’s copy.

## Specific Diagnoses

## Vertebral Fractures

Vertebral fractures and subluxations, especially those of the cervical spine, have carried some of the highest indemnity payments of all recent malpractice claims. The majority of cases resulting in payment were based on failure to diagnose the fracture, often by failure to obtain imaging or incorrect use of imaging. Up to two-thirds of patients with cervical injuries will have neurologic deterioration if the diagnosis is missed at initial presentation. As with other spine emergencies, the proper level of suspicion based on risk factor analysis, combined with historical and physical exam information, is the key to timely detection of these fractures.

Suspect cervical fractures in all trauma patients. These include alert patients with neck pain, patients with altered mental status or impaired communication (including intoxicated patients, children, the elderly, patients with psychiatric disturbances), patients with head trauma or other serious/distracting injuries, patients with a new neurological deficit, and patients with a concerning mechanism of injury. Gather all available information regarding the circumstances and mechanism of the trauma, as well as the patient's baseline neurologic status, early in the encounter when possible.

If a cervical spine injury is suspected, immobilize at the first opportunity (at triage if possible) with a rigid collar and assistive devices as needed. Document whether the patient arrived with immobilization in place (and that it was maintained) or the collar was applied in the ED. If intubation necessitates temporary removal of the collar, in-line stabilization should be performed during the procedure and documented. Consider using video-assisted laryngoscopy and other devices to minimize movement of the neck.

The decision whether or not to obtain imaging is critical. Either of two well-validated decision instruments, the NEXUS criteria and the Canadian C-Spine Rule (CCR), may be used to help determine which patients do **not** need imaging:

### NEXUS criteria

Under NEXUS, cervical spine radiography is indicated for patients with trauma unless all of the following criteria are met:

1. No posterior midline cervical-spine tenderness,
2. No evidence of intoxication,
3. A normal level of alertness,
4. No focal neurologic deficit, and
5. No painful distracting injuries.

These criteria are further defined in the literature – please see accompanying references. Note that “distracting injury” is a subjective concept.

### CCR

Under the CCR, cervical spine radiography is indicated unless the following criteria are met:

1. There are no high risk factors: age >65, dangerous mechanism\*, paresthesias in extremities.
2. There is any low risk factor that allows safe assessment of cervical range of motion: simple rear-end MVC\*\*, sitting position in the ED, ambulatory at any time, delayed onset of neck pain, absence of midline tenderness.
3. The patient can actively rotate neck 45 degrees to the right and left.

\*Dangerous mechanisms: fall from height >3 ft or 5 stairs, axial load to head, MVC high speed >100km/hr, rollover, ejection, motorized recreational vehicle, bicycle collision.

\*\*Simple rear-end MVC excludes: pushed into oncoming traffic, hit by bus/large truck, rollover, hit by high speed vehicle.

While both decision instruments are valid tools to identify patients who not require imaging, one's clinical judgment may certainly override the instruments in favor of imaging. Also, please note that the validity of both rules has been questioned for patients less than ten years of age. Finally, as with any decision rule, its criteria should be applied precisely. Cutting corners negates the usefulness of these rules and exposes the provider to heightened risk if imaging is improperly withheld.

The choice of imaging modality is the next important decision. The recent trauma literature indicates the superior sensitivity of CT over plain films in detecting cervical spine injury, and tends to recommend the use of CT in all trauma patients. These studies, however, usually involve higher-risk subsets of patients (patients evaluated by the trauma team, ICU patients, and obtunded patients, for example) with rates of cervical spine injury far higher than that seen in the ED in general, so any recommendations made in these studies to abandon the use of plain films entirely cannot be extrapolated to the overall ED population. There is insufficient evidence to support the exclusive use of CT in low risk patients.

CT scanning is, however, an appropriate choice in many cases. In the setting of significant head trauma, multi-system trauma, neurologic deficit, or high risk mechanism of injury, the higher risk of cervical spine injury may be an indication for CT. A related concept is that if other body areas are already being scanned, it also becomes a matter of efficiency to obtain the spine CT as well, as opposed to the significant transportation and performance delay often involved in obtaining plain films separately. In utilizing CT scanning, however, the benefit of the study should be weighed against the risk of late radiation effects. Patients with inadequate or abnormal plain films (or high likelihood of pre-existing abnormalities, such as the elderly patient) should undergo CT scanning.

If plain radiographs of the cervical spine are used, at least 3 views should be obtained: AP, lateral and odontoid views. For adequate evaluation, all 7 cervical vertebrae and the upper part of T1 must be seen. This may require special views, such as a pull-down or swimmer's view. When unable to get a complete set of plain radiographs, CT scan should be obtained, as discussed above. Flexion-extension views have high false-negative rates and introduce risk of secondary cord injury, and are not recommended.

Interpretation of cervical imaging is a high risk area: consult radiology liberally when reading vertebral plain films and CT. If the radiologist is unsure, further evaluation with MRI or consultation with a spine surgeon may be warranted. Remember to maintain c-spine immobilization throughout this process. Also, in terms of institutional procedures, it is important that preliminary radiology readings become part of the medical record, and that there is an adequate callback system in cases where findings discovered on overreadings potentially change management.

Immediate consultation is often required when a cervical fracture or subluxation, or other vertebral fracture with known or suspected epidural compression is diagnosed. Certain injuries, such as anterior subluxations and simple wedge compressions fractured, tend to be stable and the provider has more room for judgment regarding consultation. Steroids are no longer recommended in spinal cord injuries.

### **Epidural Compression Syndrome (incl. cauda equina)**

In epidural compression syndrome, the primary clinical and risk management problem is making the diagnosis before the injury becomes complete, when “classic” clinical findings may not be obvious. As discussed above, a thorough history and risk factor analysis are the most important decision-making tools when clear neurologic deficits are not yet present. Epidural compression syndrome may result from tumor (most common), midline disc herniation, abscess (discussed in more detail below), trauma, hematoma (most frequently after spinal surgery), and arteriovenous malformations. Cauda equina syndrome, which results from injury to lumbar and sacral nerve roots in the vertebral canal (usually from central disc herniation at L4-5 or L5-S1), also falls under this category. In Epidural Compression Syndrome, back pain is common, is usually worse with recumbency, and is often accompanied by radicular symptoms. Bilateral extremity symptoms suggest epidural compression. Saddle anesthesia is one of the most frequent sensory complaints, suggesting cauda equina syndrome, as do changes in bowel, bladder or sexual function. The latter deficits, if they become permanent, have an obvious disruptive and distressing impact on a patient’s life, making this area a relatively frequent source of claims. In addition, many of these patients are relatively young and still working before their symptoms progress, which creates a larger claim for monetary compensation.

Spine symptoms related to cancer usually manifest as pain first, often with pain that is gradual in onset, unrelieved by rest and severe at night or with recumbency. Prior history of malignancy is the most useful risk factor. Metastatic disease from breast, lung, and prostate cancer are the most common causes, but metastases from nearly any malignancy can cause epidural compression, as can primary tumors of the spine. In approximately twenty percent of cases, spinal compression is the initial manifestation of malignancy. Prolonged back pain in children, especially those under 10 years old, should raise concern for cancer as well as for infection.

On examination, motor weakness is more common than paresthesia or anesthesia, and usually occurs first. As discussed above, a thorough motor, sensory, and reflex exam should be performed. Hyperreflexia is seen below the level of compression in cord lesions, but hyporeflexia is seen in cauda equina syndrome. The exam should include sensory testing of the

saddle area, anal sphincter tone (decreased in 60-80% of patients with cauda equina syndrome), and postvoid residual volume. Urinary retention is highly sensitive and specific, but a late sign.

Early diagnosis is imperative, as neurologic status at the time of diagnosis is the principal determinant of functional outcome. This is especially true with bladder function in cauda equina syndrome. MRI is again the best imaging choice and due to the frequency of multiple spinal lesions in this population, imaging of the entire spine is recommended if metastatic disease is a concern. Plain radiographs have insufficient sensitivity and specificity to be useful. Prompt surgical consultation, along with early administration of steroids (and analgesia) are normally the recommended treatments. The proper dose of steroids remains controversial, with loading doses from 10mg to 100mg of intravenous dexamethasone having been found to be of benefit. Urgent decompression is usually indicated where the cause is felt to be reversible. While delays of up to 48 hours for surgical decompression have been shown in some studies to be permissible, the literature is not conclusive, and perceived delays in treatment may result in litigation. In cases caused by tumor, however, radiation therapy may be indicated, and steroids may not be indicated if no neurologic deficit is present.

### Spinal Epidural Abscess

Spinal epidural abscess (SEA) is a rarely made diagnosis, but increasing numbers of patients are at risk due to factors such as age and spinal procedures. *S. aureus* (up to 50% may be MRSA in some locales) is the most common organism, followed by other gram positives and gram negatives (such as *Pseudomonas* in IVDA patients). Other agents, such as anaerobes and mycobacteria, are rare. Infection may reach the epidural area not only by direct spread from osteomyelitis or spinal procedures, but also by hematogenous spread, so history or presence of other bacterial infection should be noted. SEA may cause spinal cord injury by direct compression or possibly by vascular occlusion caused by thrombophlebitis. Despite rising clinician awareness the diagnosis of and potential devastating effects of SEA, improved imaging capability, and expanded antibiotic treatment options, irreversible neurologic deficit occurs in up to 45% of SEA patients, and death in about 5-15%. The diagnosis is usually not made on the first ED visit.

The classic presentation of SEA is back pain, fever, and neurologic deficit, but the complete triad is present in less than 15% of cases. Back pain is the most common symptom initially (over 70% of patients), followed by fever (50%) and neurologic deficit (as low as one third). Up to 35% of patients have bowel or bladder incontinence at presentation. Altered mental status and meningeal signs may also be present. The lumbar spine is most frequently affected, but SEA may occur in the thoracic and cervical spine, and the abscess often spans several vertebral levels. WBC count is relatively insensitive, with only approximately 60% having greater than 12,000 cells/mm<sup>3</sup>. Early diagnosis is therefore difficult, with almost half of cases being initially missed. The somewhat nonspecific symptoms and unpredictable progression of SEA makes proper suspicion based on risk factor analysis extremely important, as the patient's ultimate neurologic outcome is largely dependent on their level of preoperative function.

MRI is the best imaging study for detection of SEA. CT with gadolinium or CT myelography may be used if MRI is contraindicated or unavailable. WBC and blood cultures (which identify

the responsible pathogen at least 60% of the time) should be obtained. CSF analysis is not recommended, as it is low-yield and adds risk. Definitive treatment involves decompression and abscess drainage, along with broad-spectrum antibiotics. Intravenous vancomycin with ceftazidime or cefipime is one such regimen. Non-surgical treatment in selected cases has been described, but is controversial and more data is needed. Prompt consultation with a spine surgeon should be initiated from the ED, as neurologic symptoms may progress rapidly.

## Osteomyelitis

Infection of the vertebral body has similar risk factors to those for SEA, and the two diagnoses will often coexist. Onset of symptoms, most frequently back pain, is usually over weeks to months. The spinous processes of the involved vertebrae will often be tender. Neurologic deficit is present in less than 20% of patients. The presence of fever is insensitive.

Less than half of osteomyelitis patients have an elevated WBC. ESR and CRP are more sensitive, but not very specific. Blood cultures are often helpful in ongoing management, as described above. Plain films may show bony abnormalities, but they are insufficiently sensitive for sole use. MRI (preferred), bone scanning, and CT are more useful.

Treatment normally consists of broad spectrum antibiotics after culture and possibly after bone culture is taken, if the consultant requests it and time allows. Surgical intervention should be considered for fluid collection, existing or impending cord compression, or failure of medical treatment.

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## Summary Points

### History

- Thorough history taking is the key to timely diagnosis, as it allows the provider to have the proper level of suspicion for a spine emergency and obtain appropriate testing and consultation.
- In addition to investigation of the patient's symptoms, the provider must ask about additional "red flags" for spine emergencies, such as cancer and IVDA.
- Use all available resources for history gathering.
- Do not forget about conditions that may mimic spine pathology.

### Physical examination

- The patient should be undressed, and should be examined in as private a setting as possible.
- Vital signs must be complete, and any abnormal signs addressed, especially fever.
- The neurologic exam must address motor, sensory, and reflex testing for each relevant spinal level, including the anogenital area if indicated, as well as mental status and gait.
- Postvoid residual bladder volume should be tested with complaint of incontinence or if epidural compression is suspected.

## **Testing**

- Aggressively pursue testing when a spine emergency is suspected, but no testing should be done in the absence of red flags in the history or physical examination.
- In nontrauma cases, MRI is generally the best imaging modality. Plain films are of little use.
- In trauma, the NEXUS and Canadian decision instruments may be used to determine which patients do not need cervical spine imaging.
- If the trauma patient does require cervical spine imaging, CT should probably be used if the patient is felt to be more than a low risk for cervical injury. Plain radiographs may be used for patients felt to be at low risk.
- White blood cell count is insensitive in spinal infection, with ESR and CRP being more sensitive but less specific.

## **Treatment**

- Immobilization should be initiated at first opportunity and maintained until no longer required.
- If sufficient suspicion for infection or epidural compression exists, consider treatment with antibiotics and/or steroids (where applicable) before the imaging results are available.
- The same principle should apply for consultation with a spine surgeon.

## **Documentation**

- Insufficient documentation is a common theme in malpractice claims that end in large payments to plaintiffs.
- Cover the “red flags,” including the pertinent negatives.
- Document the neurologic exam in detail: documenting the exam as “normal” or “non-focal” adds uncertainty for that may adversely affect the defense of a malpractice claim.
- The chart should “tell the story” of the encounter, including medical decision making and risk factor analysis.

## **Discharge instructions**

- Spine emergencies are frequently not diagnosed at the first ED visit.
- Make sure that discharge instructions clearly direct patient to return immediately if there are new or worsening motor symptoms, bowel/bladder changes, saddle anesthesia, or other worrisome concerns.

## Module 7: CNS-Spine References

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