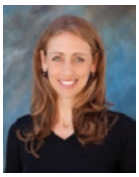
Pain in the Neck

Cervical Spine Injuries in Athletes

LESSON 19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OBJECTIVES

On completion of this lesson, you should be able to:

1. Devise a systematic approach for the evaluation of suspected c-spine injuries.
2. Describe the history and physical examination findings that should raise suspicion for a c-spine injury.
3. Explain evidence-based clinical decision tools that help determine the need for imaging of the cervical spine.
4. Recognize transient neurological deficits that can mimic more serious diagnoses.
5. Define the initial stabilization and management of a suspected c-spine injury.

FROM THE EM MODEL

18.0 Traumatic Disorders
18.1 Trauma

CRITICAL DECISIONS

- What is the appropriate initial assessment for a suspected c-spine injury?
- What history and physical examination findings should raise concern for a c-spine injury?
- When should the cervical spine be imaged?
- What are the most common vascular injuries associated with c-spine trauma?
- What are the most common transient neurological injuries associated with c-spine trauma?
- What has changed in the management of patients with c-spine injuries?

Although musculoskeletal complaints are common among athletes who present to the emergency department, injuries to the neck, especially the cervical spine (c-spine), warrant serious concern. Clinicians must be prepared to recognize and manage the complex and potentially devastating complications associated with acute neck pain. In particular, injured athletes must be promptly evaluated for vertebral fractures, subluxation injuries, vascular injuries, intervertebral disc herniation, brachial plexus injuries, and/or nerve root injuries.

CASE PRESENTATIONS

CASE ONE

A 24-year-old woman with a potential c-spine injury arrives via helicopter. She was transported from a nearby trail after being thrown from her horse. Her group, which was 45 minutes away from the nearest access road, stabilized her head and neck while waiting for EMS. Rescue personnel found the patient to be awake, oriented, and in a supine position, but complaining of severe neck pain. She did not lose consciousness at the scene and could move her extremities; she denied headache, nausea, and blurry vision.

EMTs noted the patient's intact helmet lying approximately 10 feet away from her. She reported tenderness in her cervical spine, but her field examination was otherwise normal. EMTs applied a cervical collar and used a "scoop stretcher" to transfer the patient to a cot.

On arrival at the emergency department, the patient complains of increasing neck pain.

CASE TWO

A 16-year-old boy presents after being tackled during a high school football game. Upon falling to the ground, he experienced a sharp, "electric pain" that originated in his neck and moved down his left arm. He did not lose consciousness during the event and was able to immediately get up without assistance, remove his helmet, and walk over to the sideline, where he was evaluated by the athletic trainer. He denied headache, nausea, or blurry vision.

At the time of the injury, he had no midline c-spine tenderness, no step-offs or deformities, and complained only of pain and paresthesias in his left arm. Approximately 10 minutes after the injury, however, his left arm began to feel weaker, so his parents brought him to the emergency department for further evaluation. On arrival, he continues to complain of neck pain and unilateral upper-extremity paresthesias and weakness.

Acute spinal cord injuries (SCIs) in athletes are rare (accounting for only 2.4% of all athletic-related hospitalizations), yet 9.2% of all SCIs in the US are sustained during athletic activity.[1] Although football players, wrestlers, and gymnasts are at greatest risk for c-spine trauma involving axial loading, hyperextension, traction, or rotation, such injuries can occur during almost any recreational activity, including those traditionally considered noncontact sports, including baseball.[1]

CRITICAL DECISION

What is the appropriate initial assessment for a suspected c-spine injury?

As with all traumatic injuries, emergency physicians should approach patients with suspected c-spine injuries using the Advanced Trauma Life Support (ATLS) protocols, which strive not only to identify immediate threats to life, but also to minimize the risk of overlooking secondary and tertiary injuries.[2] Generally, if the neck of a patient with a potential c-spine injury has not already been stabilized to minimize movement, it is essential to do so by providing in-line stabilization before proceeding with the evaluation.[3] If a patient is not breathing, is unable to manage secretions, or displays signs of impending respiratory failure, the airway should be secured before proceeding.[4]

Many physicians question the safety of emergency airway management — using orotracheal intubation — with known or suspected c-spine injuries; however, several studies have shown orotracheal intubation with in-line stabilization to be a safe and effective method for definitive airway management in patients with suspected c-spine injuries.[5-8] No consensus has been reached on whether video-assisted laryngoscopy (VAL) is safer than direct laryngoscopy (DL) with respect to minimizing vertebral body movement during the intubation process.[6]

Studies have produced mixed results on the use of VAL. One study concluded that there was no significant difference between DL and VAL at any level of c-spine injury, while another found that c-spine motion was reduced by 50% at the C2-C5 segment when VAL was used.[9,10] Regardless, current ATLS guidelines list orotracheal intubation with in-line manual c-spine stabilization as the definitive airway procedure in apneic patients with trauma.[9] In addition, a surgical airway should be considered if a definitive airway is required and cannot be established by other means.[6]

Once the airway and breathing have been addressed, circulation and the degree of disability should be assessed. More specifically, athletes with suspected c-spine injuries should be evaluated for signs of spinal and/or neurogenic shock. Spinal shock — a state of transient loss of spinal cord function below the level of the injury, including hyporeflexia or areflexia with associated autonomic dysfunction — occurs immediately after an injury. Spinal shock can cause an acute, incomplete SCI that mimics a complete SCI.

The severity and duration vary with the spinal level and degree of injury, but spinal shock usually lasts less than 24 hours. Patients can experience an initial increase in blood pressure due to the release of catecholamines, quickly followed by hypotension. The bulbocavernosus reflex (S2-S4) can be used to help diagnose spinal shock; it can be tested by monitoring for the contraction of the anal sphincter in response to squeezing the glans penis or clitoris, or to a slight tug on an indwelling Foley catheter, in patients with acute paralysis after trauma. Presence of the reflex indicates spinal cord severance; its absence indicates spinal shock. The return of the reflex typically indicates that the spinal shock is resolving.[3]

By comparison, neurogenic shock is the body's response to the sudden

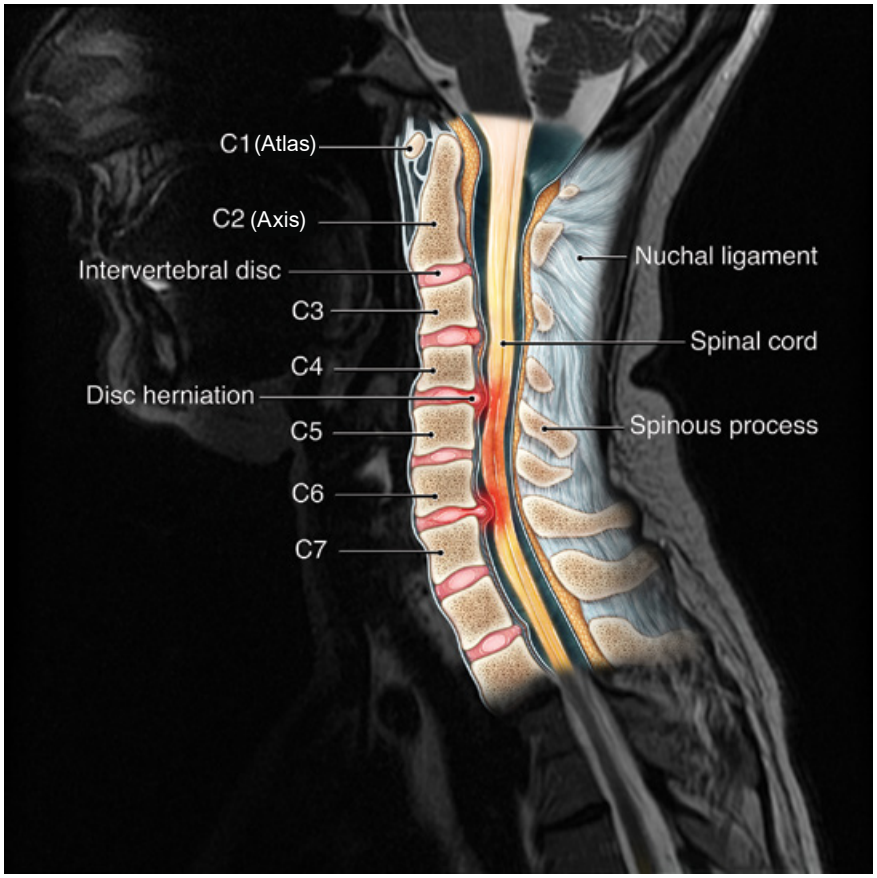
loss of sympathetic control. It is a distributive shock that manifests itself clinically with bradycardia, hypotension, flaccidity, and areflexia. Neurogenic shock typically occurs in patients with SCIs above the T6 level, as these translate into greater than 50% loss of sympathetic innervation, which leads to unopposed vagal tone, a decrease in vascular resistance, and associated vascular dilation. For hypotensive trauma patients, it is crucial not only to distinguish between spinal and neurogenic shock, but also to rule out hypovolemia as the cause of shock.[3]

Disability should be assessed by performing a head-to-toe neurological examination. If an athlete arrives wearing protective equipment, the equipment may need to be removed prior to full evaluation. If a spinal injury is strongly suspected, initial imaging can occur prior to equipment removal, as most athletic equipment is radiolucent.

If a long spine board is used for spinal stabilization during transport, it should be removed upon arrival, maintaining in-line stabilization of the spine. A slider board can be used to minimize motion during additional transfers. Once the long spine board and sports equipment are removed, a rigid cervical collar should be applied, if not already placed in the prehospital setting, and should remain in place until the cervical spine is "cleared," either clinically or radiographically.

A more detailed history should be obtained, in conjunction with a secondary survey and a more detailed exam. Ideally, the mechanism of injury should be determined so that the presence of coexisting injuries can be ascertained. It is important to know if a helmet was used and whether or not it was damaged in the incident, as this information can help stratify the direction and force of the injury.[3]

FIGURE 1. Cervical Spine Injury, MRI Sagittal View



This patient was involved in an automobile accident that resulted in intervertebral disc herniations compressing the spinal cord, primarily at the level of C4/C5 and C6/C7. The image also depicts a reverse curvature of the cervical spine, a common injury sustained when muscles and tendons are strained during high-velocity movements.

CRITICAL DECISION

What history and physical examination findings should raise concern for a c-spine injury?

C-spine injuries are classified according to the mechanism of trauma, the extent of vertebral stability, and the morphology of the injury. As such, the most common injury patterns in athletes are related to axial loading, flexion, extension, and rotation. One key purpose of the physical exam is to detect primary injuries, such as damage from direct contusion and axonal stretch, spinal compression by bone fragments, hematoma or intervertebral discs, and ischemia from damage due to the impingement on the spinal arteries.[6]

The cervical spine should be carefully inspected from the nuchal ridge to at least the spinous process of the first thoracic vertebra.[11] In addition, clinicians should pay close attention to any obvious neck deformities or signs of instability. The posterior aspect of the neck should then be palpated by placing thumbs on the spinous processes and applying circular pressure down the midline to detect tenderness. This process should be repeated 2 cm to 3 cm lateral to the midline on both sides to assess for facet pain.

Depending on the mechanism of injury and complaint of pain, a focused assessment of the lateral and anterior aspects of the neck also should be considered.[12,13] Physicians should suspect acute abnormalities if tenderness, deformity, edema, ecchymosis, and/or acute muscle spasm are present.[3] Following inspection and palpation, a thorough neurological evaluation should be performed, including an assessment of sensation, motor function, and reflexes. Table 1 outlines the motor, sensory, and reflex functions that are lost or decreased with injury at the respective cervical spinal levels.

During the evaluation, both nerve root and spinal cord injuries should be considered. Although sometimes

difficult to detect, the presence of neurological deficits that indicate multilevel involvement generally suggest spinal cord trauma, rather than a nerve root injury. Additionally, in the absence of spinal shock, motor weakness with intact reflexes indicates a spinal cord injury. In contrast, motor weakness with absent reflexes often indicates a nerve root lesion.[3,6]

Cervical spine injury can also present more subtly, so it is important not to discount a serious injury due to a lack of pain, as neck pain may not necessarily be severe or it may not be as severe as other distracting injuries.[12] One study found that most patients with c-spine injuries did not present with a history of loss of consciousness or with neurological deficits. Many had no evidence of craniofacial trauma, and some patients exhibited full range of cervical motion.[14] Regardless, any indication of neurogenic and/or spinal shock should raise concern for a potential SCI.

CRITICAL DECISION

When should the cervical spine be imaged?

Studies have shown the high cost and relatively low yield of indiscriminate c-spine imaging in trauma patients. However, significant variation exists between prehospital and emergency department assessments, so clinicians should avoid discontinuing spinal stabilization until the cervical spine has been adequately assessed and cleared.[15]

Standard x-rays remain the initial imaging study of choice for low-risk patients and those without a significant mechanism of injury. For patients with multiple traumatic injuries or a high suspicion for injury, however, many hospitals now opt to use standard CT scans as part of the initial evaluation of the cervical spine. CT scans can provide greater detail and can create multi-axis reconstructions that are better suited for patients with high-risk injuries.[6]

Although CT is an excellent modality for evaluating bony spine injuries, MRI may be indicated in patients who, despite a negative scan, have persistent midline tenderness and/or neurological abnormalities. Since MRI (*Figure 1*) provides more detailed imaging of the spinal cord, spinal canal, spinal ligaments, intervertebral discs, and paraspinal soft tissues, it can be particularly useful when neurological deficits are caused by hemorrhage, edema, or injury to the spinal cord. MRI can also help determine the acuity of bony injuries and aid in the assessment of vascular injury.[16,17] Despite access to CT scans and MRIs, it is important to remember that plain films can still provide rapid assessment of alignment, fractures, and soft-tissue swelling.[6]

Clinically, the mechanism of injury alone should not determine the need for radiological investigation. Although it is rare to see an unstable c-spine fracture or neurological deterioration due to injury in an asymptomatic patient, emergency physicians should use clinical decision rules to help determine whether low-risk patients can forego imaging.[18,19]

The National Emergency X-Radiography Utilization Study (NEXUS) and the Canadian C-Spine Rule (CCR) are two widely used and evidence-based decision tools that can be used to evaluate patients with suspected cervical trauma to determine the need for imaging. These rules allow emergency physicians to make objective decisions about imaging, which can result in cost savings and reduced radiation exposure to patients. Both rules have been validated to provide useful, highly sensitive criteria to ultimately reduce the need for imaging.[6,11,20]

NEXUS has a 99.8% negative predictive value for c-spine injury with a sensitivity of 99% and specificity of 12.9%. Because of its low specificity, researchers were concerned that the NEXUS criteria still resulted in overimaging and thus developed the CCR. The objective in developing the

TABLE 1. Neurological Findings and Associated Anatomical Level

C-Spine Level	Deficit Found on Exam
C1-C2	• Paresthesia in the occipital-parietal region • Muscle weakness is rare
C3	• Paresthesia or numbness at the lower pinna, posterior portion of the cheek, temporal area, and lateral aspect of the neck • Weakness is clinically not detectable • Analgesia is rare
C4	• No paresthesia • A horizontal band of cutaneous analgesia along the spine of the scapula, mid-deltoid area, and clavicle • Slight weakness of the trapezius bilaterally
C5	• No paresthesia or sensory deficit • Weakness of the supraspinatus, infraspinatus, deltoid, and brachial biceps muscles • The biceps and brachioradialis reflexes are sluggish or absent
C6	• Paresthesia in the thumb and index fingers • Analgesia at the tips of the thumb and index fingers • Weakness of the biceps, brachialis, supinator brevis, and extensor carpi radialis • The biceps reflex is sluggish or absent
C7	• Paresthesia in the index, middle, and ring fingers • Cutaneous analgesia at the dorsal aspect of the index and middle fingers • Weakness in the triceps and flexor carpi radialis • The triceps reflex can be affected
C8	• Paresthesia in the middle, ring, and little fingers • Cutaneous analgesia of the little finger • Weakness in the extensors of the thumb, extensor and flexor carpi ulnaris, adductor pollicis, common extensor of the fingers, and abductor indicis
T1	• Paresthesia and cutaneous analgesia at the ulnar aspect of the hand • Weakness of the intrinsic muscles of the hand

TABLE 2. NEXUS Criteria

No midline c-spine tenderness on palpation
No focal neurological deficit
Normal alertness: GCS 15; alert and oriented to person, place, time, and/or events; able to correctly remember three objects at 5 minutes; and appropriate response to external stimuli
No distracting injuries, such as long-bone fractures, visceral injuries requiring surgical consultation, large lacerations or burns, and crush injuries
Patient is not intoxicated

CCR was to derive a highly sensitive clinical rule with improved specificity that would allow physicians to be more selective in the use of radiography.[11,20,21]

According to the NEXUS protocol, a c-spine injury cannot be excluded if any of the following findings are present: midline cervical tenderness, altered mental status, focal neurological deficit, evidence of drug or alcohol intoxication, or the presence of another injury that is considered painful enough to distract from a neck injury. If none of these criteria are noted, the patient is considered low risk for a c-spine injury and, in most cases, does not require c-spine imaging (*Table 2*). Patients with severe osteoporosis, advanced arthritis, cancer, or degenerative bone disease have a significant risk of injury and may warrant imaging, even without the application of a clinical decision tool. In these cases, even if none of the NEXUS criteria are present, c-spine imaging is still recommended.[6,11]

The CCR helps determine the need for c-spine imaging based on high-risk factors or the combination of low-risk factors and a physical exam finding (*Table 3*). The three high-risk factors that mandate imaging include age 65 years and older, a dangerous mechanism of injury, and the presence of a sensory neurological deficit. Low-risk factors include a simple rear-end collision, the ability to sit, ambulation at any point in time after the injury, delayed onset of neck pain, and the absence of midline cervical tenderness. If patients have a low-risk factor, they should be asked to rotate their head 45 degrees to the right and then 45 degrees to the left. If unable to do so, imaging is required.[20]

Note inclusion criteria from the two studies differ: The Canadian c-spine study did not include children younger than 16 years and patients with Glasgow Coma Scale (GCS) scores less than 15, while the NEXUS study did. One article concluded that the CCR is superior to the NEXUS criteria with respect to sensitivity and specificity for c-spine injury, and use of the CCR would reduce rates of radiography.[21] However, it is important to remember that stabilization and imaging of the spine should not take precedence over life-saving diagnostic and therapeutic procedures.[3,5]

TABLE 3. Canadian C-Spine Rule[20]

High-Risk Factors That Mandate Radiography
• Age ≥65 years
• Paresthesias in the extremities
• Dangerous mechanism:
— Fall >1 m (or 5 stairs)
— Axial load to the head/spine (eg, diving injury)
— High-speed motor vehicle accidents (>100 km/hr)
— Motorized recreational/all-terrain vehicle accidents
— Ejection from a vehicle
— Bicycle accident with an immovable object
Low-Risk Findings That Allow for Further Evaluation With Range of Motion Testing **Patients who DO NOT have one or more of the following should have radiographs:**
• Simple, rear-end motor vehicle collision
• Patient in seated position in the emergency department
• Patient ambulatory at any time since the injury
• Absence of midline neck tenderness
• Delayed onset of neck pain
Range of Motion Testing
Can the patient move the neck 45 degrees to the right and left (regardless of pain)? If yes, then no imaging is required.

CRITICAL DECISION

What are the most common vascular injuries associated with c-spine trauma?

For a patient with a suspected c-spine injury, the need to evaluate for skull and intracranial injuries is often recognized. Although traumatic vertebral artery injury is well recognized in trauma, it can often be overlooked in a patient with c-spine trauma. Its incidence increases greatly in the presence of a head or c-spine injury. Traumatic vertebral artery injuries are most commonly precipitated by blunt trauma or a rotating or bending mechanism.

Symptomatic injuries can manifest posterior circulation ischemia, such as dysarthria, ataxic gait, visual field defects, Horner syndrome, impaired consciousness, or impaired balance and coordination directly after injury. However, many injuries can remain asymptomatic, which presents a clinical challenge. If an injury goes undetected, it can lead to potentially fatal posterior circulation ischemia.[23,24]

Traumatic vertebral artery injuries appear to account for as much as 22% of blunt c-spine injuries; the incidence can be upward of 70% in cases of c-spine fracture. Thus, if the mechanism of injury was significant enough to produce a c-spine fracture, evaluation for vascular injuries is strongly recommended.[25,26]

Blunt traumatic vertebral artery injuries tend to occur at junctions between fixed and mobile segments of vessels, as shearing forces are particularly overwhelming in these regions. The more common mechanisms that produce such forces are hyperflexion, hyperextension, distraction, and facet dislocation forces. Cervical spine fractures that are more likely to have coexisting vertebral artery injury are those that involve the C1-C3 segment and the foramen

transversarium.[23,27] In addition, carotid artery injuries can lead to stroke-like symptoms, amaurosis fugax, Horner syndrome, and neck pain.[23]

Vascular surgery should be consulted for any suspected vascular injury. For patients with suspected blunt cerebrovascular trauma, the Denver criteria (*Table 4*) also can be used to determine the need for screening CT angiography. In addition to routine laboratory studies, it is important to obtain a basic metabolic panel, type and screen, coagulation screen, and platelet count, particularly for patients taking anticoagulants and those who may require radiological or surgical intervention.[23]

TABLE 4. Denver Screening Criteria for Blunt Cerebrovascular Injury[23]

Signs and Symptoms of BCVI
• Arterial hemorrhage • Cervical bruit • Expanding hematoma in the neck • Focal neurological deficits that do not correlate with head CT findings • Stroke on secondary CT scans
Risk Factors for BCVI
• High-energy mechanism of injury — Mid-face fractures: Le Fort II or III–type injuries — Cervical-spine fracture patterns, including subluxations, fractures that extend into the transverse foramen, and any fracture of C1-C3 — Basilar skull fracture with involvement of the carotid canal • Diffuse axonal injury with GCS <8 • Near hanging with anoxic injury • Seat belt sign or other soft-tissue injury in the neck, leading to significant swelling and/or altered mental status

CRITICAL DECISION

What are the most common transient neurological injuries associated with c-spine trauma?

Short-lived neck injuries include "stingers" (sometimes known as "burners") and transient quadriplegia (also known as cervical cord neurapraxia). These injuries can occur in almost any sport but most often occur in contact sports such as football and wrestling. Stingers are more common and reportedly affect as much as 50% of athletes involved in collision sports. Transient quadriplegia is much less common, with an incidence of approximately 1.3 per 10,000 athletes, but it is notably more dangerous.[28]

A stinger is a neurapraxia of the cervical nerve roots or brachial plexus, which manifests as a sharp, stinging or burning pain down one of the arms, and is usually due to a compression or traction force in the region of the neck and shoulder. This type of injury can occur when a player's head is abruptly twisted toward or away from an impact to one of the shoulders. The player often experiences sudden pain, as well as a paresthetic sensation in the distribution of a nerve down the unilateral arm. This discomfort typically lasts seconds to minutes, and the majority of strength and sensation returns within 24 hours. However, in some instances, it can take up to 6 weeks for strength and sensation to completely return.[28,29]

Neck tenderness and muscle spasms may or may not be present in patients with stingers, but they usually present with preserved cervical range of motion. These cases can be marked by notable weakness or decreased sensation in the affected arm; however, this weakness can be so transient that it resolves by the time the athletic trainer or physician evaluates the patient on the field. Lastly, pulses should be normal. The unilaterality, short duration of symptoms, and relatively pain-free range of neck motion can assist in discriminating between a stinger and a more serious SCI.[6,29]

By contrast, patients with transient quadriplegia typically have a bilateral burning and tingling pain, with an associated loss of strength and sensation in the affected arms and/or legs. This weakness can range from a mild decrease in strength to complete paralysis, and symptoms can last up to 36 hours. Transient quadriplegia is usually caused by a hyperextension injury to the neck, as well as axial loading of the neck. It is more commonly seen in patients that have some degree of cervical spinal stenosis or disc protrusion.[6,28]

If an injury is due to transient quadriplegia, strength and sensation will resolve, but it is difficult to know in the early moments after an injury whether a severe neurological deficit is present. Even athletes with a rapid return of all neurological function should be carefully observed and prevented from returning to play until after a spine specialist can perform a complete evaluation.[28] If an

Pearls

- For an apneic patient with a suspected c-spine injury, follow the Advanced Trauma Life Support guidelines by maintaining in-line spinal immobilization, securing the airway, and then moving on to the rest of the primary survey.
- To determine which patients need c-spine imaging, use the Nexus criteria or Canadian C-Spine Rule to guide the decision.
- Remember that stabilization and imaging of the spine should not take precedence over life-saving diagnostic and therapeutic procedures.
- Stingers and transient quadriplegia are often diagnoses of exclusion. It may be necessary to obtain imaging studies or a consultation with a spine expert to rule out more serious conditions.

athlete has paralysis or a significant neurological deficit, spinal precautions should be instituted immediately, and the athlete should be transported by ambulance to the nearest emergency department for further evaluation.

Emergency physicians must remember that stingers and transient quadriplegia are often diagnoses of exclusion. Many times, patients have a severe neck strain or herniated disc that mimics some of the symptoms associated with these transient processes. It is crucial that more serious conditions are excluded before making these diagnoses. Thus, it may be necessary to obtain imaging studies or to consult a spine expert. With standard radiographs, nondisplaced and minimally displaced fractures can be difficult to see. Additionally, the degree of cervical instability cannot be accurately obtained on standard c-spine x-rays, so a CT of the cervical spine should be performed if more serious conditions are suspected. An MRI is required if suspicion of a herniated disc injury, spinal stenosis, or spinal cord contusion exists.[28]

CRITICAL DECISION

What has changed in the management of patients with c-spine injuries?

Once a physician suspects or diagnoses a c-spine injury, a few key precautions should be taken. First and foremost, the cervical spine must be immobilized. If the mechanism was significant enough to cause a c-spine injury, a thorough investigation must then be performed to ensure that no additional, associated injuries occurred. Throughout this process, clinicians must ensure that the patient remains hemodynamically stable and that no signs or symptoms suggest neurogenic or spinal shock.[3] A consultation with a neurological surgeon should be considered, and/or the transfer of the patient to a facility with neurosurgical capabilities should be arranged, if needed.

Over the years, the administration of methylprednisolone to patients with spinal injuries has been the topic of much debate. Although the drug was once considered the standard of care, there is limited evidence to support its benefit in treating traumatic SCIs in humans.[6] Randomized, controlled trials have shown limited efficacy and many adverse outcomes for certain patient groups that receive methylprednisolone for acute SCI. In recent years, enough evidence has mounted that the administration of methylprednisolone for the treatment of acute SCI is no longer recommended. Furthermore, the Food and Drug Administration has not approved the use of methylprednisolone for the treatment of acute SCI, as no Class I or Class II medical evidence supports its clinical benefit. However, much Class I, II, and III evidence exemplifies the harmful side effects, including death, associated with high-dose steroids.[30]

Evidence is also emerging regarding the use of therapeutic cooling for patients with acute SCIs. In 2011, investigators found improved SCI outcomes with mild hypothermia in a rat model.[31] Another recent prospective study was done, in which 20 patients with a complete SCI were treated with a combination of surgical decompression, glucocorticoid administration, and regional hypothermia. These patients experienced a better recovery rate than expected for traditional forms of treatment.[32]

Given the potential confounding factors, how much of the recovery was due to cooling alone is unclear. Again, the benefit of steroid treatment for cord injury was not supported with Class I evidence, but the investigators felt that research into the effects of cord cooling should be expanded. An optimal neuroprotective temperature was not defined; however, other studies have also been promising enough to encourage further research to investigate the use of cooling in patients with acute SCIs.[6,32]

Summary

Emergency physicians must be able to identify and correctly manage patients with suspected c-spine injuries, including assessing concerning physical examination findings and high-risk mechanisms of injury. Clinical decision rules — the NEXUS, CCR, and Denver criteria — can help guide imaging and management planning. In addition to spinal cord and bony injuries, physicians must be aware of common vertebral, vascular, and soft-tissue injuries that are associated with c-spine trauma. They also must be familiar with updates in treatment options. Since athletes account for roughly 10% of SCIs in the United States, emergency physicians must be aware of which sports and mechanisms place a patient at high risk for injury.

Pitfalls

- Ignoring high-risk patients who do not fit clinical decision rules. Patients with severe osteoporosis, advanced arthritis, cancer, or degenerative bone disease have a significant risk of c-spine injury and may warrant imaging, even without the application of a clinical decision tool.
- Administering methylprednisolone for the treatment of an acute spinal cord injury, which is no longer recommended.
- Failing to maintain a high index of suspicion for vascular and soft-tissue injuries associated with c-spine injuries, especially when neurological symptoms do not match head CT findings. Left undetected, these injuries can lead to potentially fatal outcomes.

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CASE RESOLUTIONS

■ CASE ONE

The 24-year-old woman thrown from a horse underwent an assessment of her airway, breathing, and circulation that revealed an intact airway. She had nonlabored and regular respirations, as well as strong and equal pulses in all four extremities. She was acting appropriately. She had a 3-cm occipital laceration, in addition to significant midline tenderness in the cervical spine upon palpation, but no step-off, crepitus, or edema. No carotid bruits were appreciated.

Given the patient's midline cervical tenderness, the cervical collar was not removed. Because she did not have any thoracic midline tenderness, step-off, or lower-extremity paresthesias, she was cleared from use of the rigid spine board. The remainder of the exam showed 5/5 strength in the proximal and distal muscle groups, in both the upper and lower extremities. No abnormalities were found on her sensory exam.

Because her mechanism of injury was a fall from over 5 feet and her helmet sustained visible damage, concern for intracranial injury existed, so a noncontrast head CT was ordered in addition to a c-spine CT. The head CT did not reveal any evidence of acute bleeding or fractures; the c-spine CT did not reveal any fractures, dislocations, or obvious areas of instability.

The patient continued to complain of neck discomfort and a feeling of being unable to support her head. Since the imaging was unremarkable for vertebral pathology, concern for possible ligamentous injury was investigated. She continued to have normal neurovascular exams and remained hemodynamically stable. She was discharged on a nonsteroidal anti-inflammatory medication in a Miami J cervical collar, and a follow-up appointment was made to see a spine surgeon.

■ CASE TWO

The 16-year-old football player's airway, breathing, and circulation were intact. A head-to-toe exam was only significant for decreased sensation along the ulnar side of his left forearm and 3/5 muscle strength in flexion of his left elbow. It was reassuring that he did not lose consciousness during the incident and was ambulatory immediately afterward; however, the development of decreased muscle strength after the injury was concerning.

Fortunately, the clinician found no evidence of cervical step-offs or midline tenderness, and the patient had full and complete range of motion, with only mild discomfort. The patient's ability to fully range his neck, in addition to being ambulatory after the fall, made a transient neurological injury more likely than a significant SCI. Given that his symptoms were unilateral and he had some remaining strength in the affected extremity, the emergency physician suspected he had a stinger. The boy was monitored in the emergency department as his paresthesias resolved, and his strength improved to 4+/5 in the affected extremity. He was ultimately discharged and instructed to follow up with his team physician.

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