

CASE STUDY: SPINAL CORD INJURY

One in a series of case studies developed to stimulate enhancement of problem-solving techniques for physicians and nurses and paramedical personnel when challenged by patients who present with unusual or complex clinical syndromes.

This Case Study is provider approved by the California Board of Registered Nursing, provider number 9697, and Coastal Valley EMS 49-0008 for 1.0 contact hours.

LEARNING OBJECTIVES

After completion of this educational process the participant will be able to:

- Distinguish complete from incomplete spinal cord injury.
- List the clinical characteristics of central cord, anterior cord and Brown-Sequard syndromes.
- Identify the major complications of glucocorticoid (Solumedrol) infusion administered to the patient with spinal cord injury.
- List the two major clinical indicators of an incomplete spinal cord injury.

HISTORY

A 30 year-old man, after consuming approximately twelve beers over a four to six hour period of time, fell down the stairs. He was found approximately one hour later. He had been up and moving about but noted weakness of his arms.

911 was called. Responding paramedics placed him in spinal precautions and transported him to the closest emergency department.

Past history except for alcohol abuse unremarkable. There was no history of metabolic or neurologic disease.

PHYSICAL EXAMINATION IN THE EMERGENCY DEPARTMENT

Blood pressure of 123/64, pulse rate 98, respirations 24, core temperature 98.2 and oxygen saturation 92% on room air. Abrasions were noted on the left temporal area of his scalp. Examination of his ears, nose, throat, chest, heart and abdomen were within normal limits. There was an odor of ethanol by products on his breath.

Neurological examination demonstrated slurred speech, Glasgow Coma Scale of 15 and movement of all extremities with "significant weakness of both upper extremities and mild weakness of his lower extremities."

COURSE IN THE EMERGENCY DEPARTMENT

Methylprednisolone (Solumedrol) was administered, 30mg/Kg IV over a period of 15-30 minutes. An infusion of 5.4mg/Kg per hour to continue over the next 23 hours was initiated.

CT scan of the brain was reported as normal. Plain x-rays and CT of his cervical spine were also reported as normal. Blood sugar was reported as 562mg/dL. Blood alcohol level was 271mg/dL.

Remainder of the chemical panel as well as the hemoglobin and hematocrit were within normal limits.

Blood glucose was redrawn, rechecked and found to be accurate. Serum ketones were negative.

What is your interpretation of the elevated blood glucose in a person with no history of diabetes mellitus or other metabolic disease?

How would you respond to the fact the x-rays and CT scans of the brain and cervical spine were within normal limits in a patient who had profound neurologic deficits of the upper extremities and mild neurologic deficits of the lower extremities?

How would you proceed? Make sure you consider these questions and formulate a plan of action before continuing.

A magnetic resonance imaging (MRI) of the cervical spine was performed. There were signs of hemorrhage into the central substance of the cervical spinal cord.

The Solumedrol infusion was continued. Intravenous fluids and insulin were administered. Vital signs remained within normal limits. There was no evidence of bradycardia or other sign of spinal shock. The cervical spine was at all times protected in a hard collar. Patient was noted on two occasions to be incontinent. He was sleepy but when awakened was able to respond appropriately to questions. He asked for water but was unable to hold the cup. As he "sobered up" he complained of pain in the area of his cervical spine, numbness of his extremities and left shoulder and arm pain.

Phone consultation with a neurosurgeon was obtained. It was determined appropriate to transport him to a hospital with advanced neurological care capabilities. REACH was requested to effect the transfer.

ASSESSMENT STABILIZATION AND TRANSPORT BY THE REACH TEAM

The REACH crew arrived to effect transfer approximately 24 hours after injury. They noted the patient to be awake and alert. Blood pressure 128/74, pulse rate 85, respirations 14 and oxygen saturation on room air 95%.

Neurological assessment by the REACH staff demonstrated a marked decrease in voluntary anal sphincter tone although some minimal tone was present. Perirectal pain

451 Aviation Blvd., Suite 201
Santa Rosa, CA 95403

Tel: 707.324.2400

Fax: 707.324.2478

www.REACHair.com

sensation was absent bilaterally, perirectal pressure "touch" sensation was present, more prominent on the right side. The patient was able to grossly flex the arms at the elbow, but unable to extend his arms at the elbows or wrists or flex or extend the fingers. The patient was noted to have the capability of extending both lower legs at the knee, but definite weakness was present. He was able to extend and flex his ankles and toes. Sensation of his upper extremities to the level of C-8 dermatome was intact. Sensation below C-8 was "spotty". Position sense was intact bilaterally. That is he was able to perceive in his elbows, wrists, thumbs and ankles movement of those joints as well as indicate with his eyes closed, the direction of the movement, i.e., flexion or extension.

DISCUSSION

Spinal cord injury can be classified in two main forms, complete and incomplete. A complete injury is defined as one in which there is complete disruption of continuity of all spinal pathways at one or more levels of the spinal cord. The result is absent motor function, sensory and pressured ("touch") sensation and position and vibratory perception to all body areas enervated by the spinal cord tissue below the level of disruption.

Incomplete spinal cord injury can be defined as one in which there is a variable degree of loss of function secondary to partial disruption of the spinal cord, i.e., some pathways of neurological function are intact, some are disrupted- either permanently or transiently.

Some examples of incomplete spinal cord injury are:

- A. The Central Cord Syndrome- This type of injury usually results from hyperextension. Central Cord Syndrome is characterized by a disproportionally greater motor impairment of the upper than the lower extremities with variable sensory loss below the level of injury. Sacral sparing typically occurs (for an explanation of "sacral sparing" see below). An imaging examination of the spinal cord of the patients with central cord injury will typically demonstrate central hemorrhagic necrosis and swelling. (See figure A)

- B. Anterior Cord Syndrome- This type of injury usually results from hyperflexion. Anterior Cord Syndrome injury is characterized by variable loss of motor and sensory function below the level of injury. However, posterior column function is maintained. Clinically this person will present with a variable degree, perhaps even complete, of motor and sensory loss below the level of injury to the spinal cord but the capacity to perceive light touch and position sense distal to the injury is maintained. (See figure B)

- C. Brown Sequard Syndrome- This type of injury is typically the result of a penetrating injury which has damaged one side of the cord. (See figure C) Brown Sequard Syndrome is characterized by motor loss on the same side and sensory loss on the opposite side of the injury. A Brown Sequard Syndrome I vividly recall was to a police officer who was slashed with a machete severing the left half of his spinal cord in the lower cervical spine area.

Two very important determinants of an incomplete, as opposed to a complete, lesion of the spinal cord are preservation of voluntary rectal sphincter tone and perianal sensation ("sacral sparing."). To check for voluntary rectal sphincter tone insert a gloved finger in the rectum and request the patient, if cooperative, to squeeze down, as if attempting to prevent movement of the bowels. If able to do so there is substantial indication of an incomplete, as opposed to a complete, spinal cord injury, i.e., some spinal neural pathways are intact.

Also check perirectal sensation at the three and nine o'clock positions with a needle or the broken wood handle of a cotton swab.. Does the person perceive pain at one or both of these locations? If so, this is further evidence the lesion is incomplete.

The syndrome with which this gentleman presented was indicative of a central cord syndrome characterized by disproportionately greater motor impairment of the upper than lower extremities with variable sensory loss below the level of the injury. It is of interest he was able by history, subsequent to the fall, to ambulate, although the extent of his ability to ambulate, especially in his intoxicated state, is unknown.

The fact plain x-ray films and CT of the cervical spine did not show any evidence of bony or ligamentous injury is of significant interest. This gentleman had in all probability as he fell down the stairs sustained a marked hyperextension motion to his cervical spine resulting in tearing of blood vessels which perfused the central area of his cervical spinal cord. The result was central hemorrhagic cord ischemia.

Why the elevated glucose? Almost certainly the blood was drawn for determination of the blood glucose subsequent to the administration of the glucocorticoid methylprednisolone (Solumedrol) which had been administered in appropriately large doses. One consequence of glucocorticoid administration is hyperglycemia. Glucocorticoid administration, especially in such high doses, can result not only in hyperglycemia but also in gastric bleeding.

Treatment of these two potential complications respectively include the administration of fluids and insulin as well as an H-2 blocker such as ranitidine (Zantac).

A major issue over the years has been whether or not methylprednisolone (Solumedrol) is effective in ameliorating the consequences of spinal cord injury. Studies show conflicting results, most show that they do not affect the outcome, but some show they do. Consultation with the treating neurosurgeon or knowledge of local policies is essential.

KEY POINTS

- This patient was able to move his lower extremities with near normality. It would have been a serious error to infer in observing lower extremity movement that no spinal cord injury was present.
- Incomplete spinal cord injury can present with varying and complex neurological findings.
- Even subtle neurological changes should be treated as highly significant.
- Normal plain x-rays and computerized tomography studies do not rule out spinal cord injury.
- Hyperglycemia can result due to the administration of the large doses of glucocorticoid.

OUTCOME

This gentleman was fortunate. He had significant resolution of his neurological deficits. Two months subsequent to his injury his only residual is mild weakness of his upper extremities.

REACH has a particular interest in spinal cord injury. Our company has been the preferred air transport provider for Santa Clara Valley Medical Center's rehabilitation service, a major tertiary care receiving center for acute and chronic spinal cord victims in Northern California.

We would welcome any questions or comments about this case study. We would also welcome any suggestions relevant to developing a case study from an interesting case involving your unit and REACH.

Let us hear from you. Should you desire to read previously published case studies and the opportunity to receive additional CEUs, visit our website at www.reachair.com. You can do so online.

Gary McCalla, MD
Medical Director
REACH Air Medical Services

SPINAL CORD INJURY QUESTIONS: choose **all** correct answers.

1. Two important clinical determinants of an incomplete spinal cord injury are:
(Choose two)
 - A. Shoulder shrug.
 - B. Voluntary rectal sphincter tone.
 - C. Sensation above the nipple line.
 - D. Perirectal pain perception on needle stick.

2. The initial suggested loading dose (administered over one hour) of IV methylprednisolone (Solumedrol) when attempting to minimize spinal injury dysfunction secondary to acute injury is:
 - A. 5.4 mg/Kg
 - B. 10.8 mg/Kg
 - C. 20 mg/Kg
 - D. 30 mg/Kg

3. A Central Cord Syndrome is characterized by: (Choose two)
 - A. Disproportionately greater motor impairment of the upper than lower extremities.
 - B. Disproportionately greater motor impairment of the lower than upper extremities.
 - C. Variable sensory loss below the level of injury.
 - D. Loss of positional sense below the level of injury.

4. Brown-Sequard Syndrome is characterized by: (Choose two)
 - A. Motor loss on the same side as the injury to the cord.
 - B. Motor loss on the opposite side as the injury to the cord.
 - C. Sensory loss on the same side as the injury to the cord.
 - D. Sensory loss on the opposite side as the injury to the cord.

5. Anterior Cord Syndrome is characterized by:
 - A. Complete loss of positional sense below the level of injury.
 - B. Complete loss of motor function below the level of injury.
 - C. Variable loss of motor and sensory level and maintenance of positional sense below the level of injury.
 - D. A complete disruption of all spinal tissue below the level of injury.

6. Administration of large doses of methylprednisolone can result in... (Choose two)
 - A. hypoglycemia
 - B. hypothermia
 - C. hyperglycemia
 - D. gastric bleeding

7. The extent of injury to spinal neurological tissue is best identified by:
 - A. Clinical exam.
 - B. CT scan cord.
 - C. Plain spinal x-rays.
 - D. Magnetic Resonance Imaging.

