TRAUMA OF THE SPINE AND SPINAL CORD—II

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Radiology

Assessing spinal radiographs

Check

- Anterior vertebral border
- Posterior vertebral border
- Posterior facet margins
- Anterior border of spinous processes
- Posterior border of spinous processes
- Integrity of vertebral bodies, laminae, pedicles, and arches
- Prevertebral space
- Interspinous gaps
- For rotational deformity
- All three basic views of cervical spine and two of thoracolumbar spine
- Lateral view of sternum (for unstable thoracic injury)

Position of patient for swimmer's view.

Good quality radiographs are essential for accurate diagnosis of spinal injury, and these are best obtained in the radiology department if circumstances allow. When spinal injuries are suspected radiographic examination should be supervised by a doctor to ensure that there is no unnecessary movement of the patient. Collars, sandbags, and splints are not always radiolucent, and it may be necessary to remove them once preliminary films have been obtained. Riggins found that there was no radiological evidence of trauma in 17% of patients with spinal cord injury.¹ When in doubt seek a radiological opinion, especially with radiographs of children, which are difficult to assess.

Cervical spine

In a patient with multiple trauma radiographs of the cervical spine, chest, and pelvis are mandatory. If there is depression of consciousness skull radiographs or a computed tomographic scan of the head (if available) are required.

Most radiologically detectable abnormalities of the neck are shown in a standard lateral radiograph, which must display all seven cervical vertebrae if injuries are not to be missed. This can usually be achieved by applying traction to both arms, but pain in the neck or exacerbation of neurological symptoms must be avoided. If the lower cervical vertebrae are still not adequately shown a "swimmers view" or standard computed tomograms can be requested. These are helpful in excluding important lesions at the cervicothoracic junction.

Swimmer's view showing dislocation of C6 on C7.

Compression fracture of C7, missed initially because of failure to show the entire cervical spine.

Open mouth odontoid view showing a Jefferson fracture of the atlas with outward displacement of the right lateral mass.

The lateral radiograph will normally show fractures, subluxations, and dislocations. Unilateral facet dislocation is associated with forward vertebral displacement of less than half the diameter of the vertebral body. This produces a change in the rotational orientation of the spine at the level of injury. Displacement of more than half the vertebral width normally indicates bilateral facet dislocation.

Unilateral facet dislocation between C5 and C6.

Bilateral facet dislocation between C5 and C6.

Many patients present with more subtle signs of an unstable injury. A chip fracture of the lower and anterior margin of the vertebra is commonly associated with a flexion injury, which may produce widening of the interspinous gap, loss of normal cervical lordosis, and minor subluxation. Always look for a prevertebral haematoma, which is indicated by an increased gap between the nasopharynx or trachea and cervical spine. The retropharyngeal space (C2) should not exceed 6 mm in adults or children, whereas the retrotracheal space (C6) should not exceed 22 mm in adults or 14 mm in children. (The retropharyngeal space widens in a crying child.)

Odontoid fracture with posterior displacement of the anterior arch of the atlas.

The other standard radiographs of the cervical spine are the open mouth odontoid view and the anteroposterior projection. Abnormalities are more likely to be seen in the odontoid radiograph (for example, Jefferson fractures of the atlas as well as odontoid fractures), but the atlantoaxial joint must not be obscured by overlying teeth. In the anteroposterior radiograph look closely at the upper thoracic vertebrae and the first two ribs. Also take care to examine the alignment of spinous processes, which may be displaced laterally at sites of unilateral facet dislocation.

When standard radiographs are normal but cervical injury is suspected flexion and extension radiographs may be obtained later as long as neurological symptoms and signs are absent. Even these radiographs, however, may show no evidence of instability in children with cord injury or adults with cord compression resulting from spondylosis or acute disc prolapse. Rupture of the transverse ligament of the atlas is associated with an increased atlanto-odontoid gap, which should not normally exceed 2.5 mm in adults and 4 mm in children.

Supine oblique radiographs of the cervical spine help to confirm the presence of facet dislocation if standard radiographs are difficult to interpret, particularly those of the cervicothoracic junction.

Fracture dislocation of T11 on T12.

Thoracolumbar spine

Anteroposterior and lateral radiographs are the standard radiographs of the thoracolumbar spine. Unlike a cervical haematoma a paravertebral haematoma in the thoracolumbar region is best seen on an anteroposterior radiograph, in which it may be responsible for mediastinal widening that resembles aortic dissection. In the lateral radiograph particular importance should be attached to subluxation, burst fractures, or potentially unstable fractures through the posterior vertebral complex (laminae and pedicles). The upper thoracic spine is usually difficult to assess in the lateral radiograph, and if symptoms or signs indicate, tomograms or computed tomograms should be considered.

Injuries of the thoracic spine can be rendered unstable by fractures of the ribs and sternum, which must be examined by radiography. An appreciable force is required to produce an unstable thoracic injury, which is usually evident in the standard radiographs.

Treatment

Skull traction using Gardner-Wells caliper with neck roll in position to maintain postural reduction.

Cervical injuries

At the district hospital orthopaedic surgeons should participate in the patient's management at an early stage. Unstable cervical injuries may be immobilised by a firm collar or skeletal traction. No technique is foolproof, and treatment should be supervised by a senior member of the medical staff. Skull traction helps to correct the alignment of the injured spine, reduce fractures and dislocations, decompress the cord and nerve roots, and provide stability.

Halo applied with bale arm—an alternative approach to skull traction if early mobilisation into a halo brace is being considered.

Various skull calipers are available, but the Gardner-Wells caliper is easily applied, carries a low risk of complications, and has been used at the scene of accidents. In recent years halo traction has become more popular. Care must be taken not to overdistract injuries of the upper cervical spine, and for some of these traction is contraindicated.

Conservative treatment for thoracolumbar injuries (postural reduction).

Thoracolumbar injuries

Thoracolumbar injuries may be treated by "postural reduction," which entails bed rest on a lumbar support to maintain the normal lordosis and help reduce the fracture or dislocation. Doctors commonly operate on patients with unstable injuries to enable them to be mobilised without much delay and to facilitate nursing care, though this approach is controversial.

Patient immobilised in a Royal Air Force pattern turning frame for transfer to a spinal injury unit. Skull traction is maintained by means of the constant tension device.

Spinal injury associated with paraplegia or tetraplegia

Because of the medical complications associated with paraplegia or tetraplegia early referral and transfer to a spinal centre allows the patient to receive better overall care. Many spinal centres have intensive care units, and staff are experienced in dealing with complicated cases. Referral should be the responsibility of the orthopaedic or neurosurgical team. Routine administration of steroids, mannitol, and antibiotics in these patients is controversial. There is no conclusive evidence that surgery improves neurological outcome, but it is undertaken when there are signs of deteriorating neurological function and also to prevent deformity. The prognosis is always uncertain, and patients should therefore be treated actively.

1 Riggins R. The risk of neurologic damage with fractures of the vertebrae. *J Trauma* 1977;17:126-33.

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Lesson of the Week

Children with croup presenting with scalds

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Inhalation of steam is often prescribed for viral croup, but its benefits remain unproved and the risk of scalds must be emphasised to parents

Inhalation of mist or steam has never been proved to be beneficial in viral croup, and it is unclear whether low humidity has adverse effects. Humidity is still, however, commonly prescribed. We report two recent cases in which children sustained scalds while inhaling steam at home.

Case reports

Case 1—A 10 month old boy was admitted to the paediatric high dependency unit with croup and scalds affecting 12% of his body surface area. Stridor had developed 24 hours before admission, and the family doctor had recommended steam treatment. This had been attempted by holding the child over a bath half filled with boiling water, but he had struggled and fallen into the bath. On admission he was distraught but not cyanosed. Inspiratory stridor, sternal retraction, and subcostal recession were noted. He had scalds on his back, arms, and shoulders; these were predominantly superficial but were of partial thickness in some areas. He received albumen and crystalloid according to the Muir and Barclay formula.¹ His stridor settled over seven days, and his scalds healed without short term complications.

Case 2—A 4 year old boy presented to the accident and emergency department with scalds sustained while he was receiving steam treatment for croup; he had had stridor for 18 hours. His mother had placed a boiling kettle on the floor, and he had sat on her knee. He had worked himself free and fallen to the ground, kicking the kettle over. He had suffered superficial scalds to his hands and feet but did not require any fluid replacement. His stridor, however, worsened, and he was admitted to hospital, where he required intubation for

three days. Three days after extubation he was free from stridor and was discharged.

Discussion

The use of added humidity in croup is based on the clinical observation that in some cases some improvement occurs. The physiological basis for this is obscure, but it is generally believed that inhaled humidity prevents drying and further swelling of the inflamed laryngeal mucosa.² In one of the few studies on this subject Sasaki and Suzuki examined the response to increased humidity in kittens and cats.³ They reported a change in the pattern of breathing that enhanced respiratory airflow in partially obstructed upper airways. This response was related to age, being more prominent in kittens, and they postulated that it was mediated by laryngeal mechanoreceptors. Only one controlled trial has been performed in children, who were randomly assigned to environments with either high or normal humidity.⁴ Heart rate, respiratory rate, and transcutaneous oxygen and carbon dioxide tensions were measured over 12 hours, with no significant difference between the two groups.

Many people believe that, although the therapeutic role of humidity has not been proved, it can do no harm. Our cases show the dangers of inhaling steam at home, and we recommend that these be pointed out to parents if this treatment is prescribed.

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- 2 Henry R. Moist air in the treatment of laryngotracheitis. *Arch Dis Child* 1983;58:577.
- 3 Sasaki CT, Suzuki M. The respiratory mechanism of aerosol inhalation in the partially obstructed airway. *Pediatrics* 1977;59:689-94.
- 4 Bouchier D, Dawson KP, Fergusson DM. Humidification in viral croup: a controlled trial. *Aust Paediatr J* 1984;20:289-91.

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