Chapter 9

Imaging of the Spine and Spinal Cord

J. S. Lapointe

Introduction

Between 1896, when Roentgen discovered X-rays and 1975, when spinal computed tomography (CT) became available thanks to improvements to Hounsfield's 1971 invention, the spinal cord had to be studied by indirect means. Plain film radiography, and linear and complex motion tomography were used to image the bony spine. The outline of the spinal cord was first seen with pneumomyelography, after Dandy outlined the medulla with air in 1919 but a safe opaque contrast medium for myelography was only introduced in 1940. This iophendylate (Pantopaque) was replaced by non-ionic water-soluble metrizamide (Amipaque) in 1973. Spinal angiography, since its introduction by Djindjian in 1963, has had a limited role in the investigation of vascular lesions of the spinal cord.

After 1975, perfected CT body scanners made axial images of the spinal cord possible. With the aid of intrathecal contrast, better visualization of the contour of the cord and its position within the spinal canal was achieved. Following improved resolution of the CT scans in the 1980s, cysts, haemorrhages, and tumours within the substance of the cord could be detected without intrathecal contrast and without or with intravenous contrast enhancement (Ruggiero et al. 1981). At the same time, rapid progress in the image quality of magnetic resonance studies was being made and the first clinical units became available at the beginning of the 1980s. This new and expensive technology, whose first images were produced by Lauterbur in 1973, will be the imaging modality of choice in the 1990s for diseases affecting the spinal cord, as it is the first method which consistently outlines the substance of the cord in any plane and the effect of the surrounding tissues on it. Recent advances have increased the resolution in MRI of the cord to the point that grey and white matter differentiation is possible.

Imaging Tools

In this period of concern over health care costs, it is important for the physician ordering examinations to understand what information each type of examination is
likely to yield, and to tailor these requests to the patient’s neurological status. The availability of the technology should not be the only determining factor in the choice of examination. The degree of radiological expertise available and the familiarity with the conditions being studied are also very important. If the patient is to be transferred to a more specialized centre for management, it is often advisable to have that centre’s neuroradiologists perform the examinations, to reduce unnecessary duplication and to increase diagnostic yield. While the following is not all-inclusive, its aim is to elucidate what place these examinations have in the overall investigation.

Plain Films

Plain film radiography (Banna 1985) is available in all radiology departments and is the first radiographic examination performed when trauma to the spine has been sustained. Obtained supine, often on a trauma board, with the neck in a brace or collar, the examination consists mainly of AP and cross-table lateral films. In an uncooperative patient, it may be difficult to obtain a good open-mouth view to see the base of the odontoid. When the patient has a short neck or wide shoulders, a swimmer’s view will delineate the cervicothoracic junction. Oblique views of the cervical spine may not be routinely obtained in trauma. Satisfactory information may be gained by angling the X-ray tube without moving the patient, resulting in a somewhat distorted view of the oblique cervical spine. Another method is to obtain oblique views of the cervical spine by doing oblique scout views (digital radiograph) by CT. These add only a few seconds to a CT examination of the head. Alignment of pedicles and shingling or imbrication of the laminae can be easily ascertained by either method, attesting to the normal alignment of the vertebral bodies and obviating the need for spinal precautions in the multi-traumatized patient (Fig. 9.1a and b).

The size of the intervertebral foramina and the integrity of the pedicles and laminae are assessed on routine oblique views of the cervical spine, while oblique views of the lumbar spine help to assess the pars interarticularis and the apophyseal joints. Flexion and extension views are performed if abnormal mobility of the spine, usually at the cervical level but occasionally at the lumbar level, is suspected. Ligamentous injury of the cervical spine can easily be missed on the initial supine study. These flexion and extension views should always be performed with the patient’s cooperation and in a sitting or standing position when the patient’s condition permits. Supine flexion and extension films done passively may give the physician a false sense of security and not demonstrate the presence of ligamentous injury. Spinal precautions should be maintained as long as instability is still suspected.

Tomography

Tomography is of two types, linear and complex motion, and is equipment dependent. The second type better delineates bony detail and is used to study complex congenital anomalies of the spine such as segmentation anomalies and scoliosis. It is also used to study fractures of the spine, where CT scanning is not available. As many cases of trauma occur in young people, CT scanning is preferred because the dose of radiation is much less with CT scanning than with tomography, and the examination