Transverse Diameter of Cervical Spinal Cord on Pantopaque Myelography

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Gross changes in the size of the cervical spinal cord as a result of an expanding intramедullary lesion or marked atrophy usually can be recognized by simple inspection of Pantopaque myelograms. When changes are of a minor degree, however, recognition may be difficult. In such instances, knowledge of the extent of the variation in the size of the normal cervical spinal cord would be of great value. Because of technical problems, however, consistent and reproducible measurements are difficult to obtain.

Porter, in a study of 63 normal Pantopaque myelograms, measured the distance between the points of emergence of the nerve roots from the cord at the 4th and 6th cervical levels only. These measurements varied between a minimum of 1 cm. and a maximum of 1.7 cm., with an average width of 1.4 cm. It is difficult to relate these figures to the total transverse diameter of the cord. Wood described in detail the appearance of the cervical cord as seen on spot films. According to this author, the cervical spinal cord occupies the central two-thirds of the cervical subarachnoid space and the "width of the spinal cord is approximately one-half the interpédiculate distance except at the level of the maximum cervical enlargement at C-5, where the spinal cord occupies almost two thirds of the vertebral canal." Standards for the sagittal diameter of the cervical spinal cord on air myelography were reported by Lowman and Finkelstein.

Measurements derived from conventional spot films made during cervical myelography are subject to criticism on several bases. To a limited but unknown degree, the factors of magnification vary from patient to patient and are dependent upon the particular geometrical factors incorporated into the equipment used for the examination. An additional complicating factor is introduced when the neck is hyperextended in order to prevent opaque material from entering the cranial cavity. With hyperextension, the upper cervical segments, particularly C1, C2 and the cervicodorsal region, form a large angle with the plane of the film. As a result, factors of magnification for different regions of the cervical spine are not identical. In actual practice, this effect often is lessened by decreasing the hyperextension when the tilt-table has been restored to a nearly horizontal position before spot views are taken. While the introduction of an adequate amount of opaque material (12 ml.) in the subarachnoid space ensures accurate measurements of the cord at most levels, complete filling in the upper cervical and upper dorsal regions frequently is difficult to achieve. Since Pantopaque cervical myelography ordinarily is performed with the patient prone, the posterior portion of the subarachnoid space is devoid of opaque material and the sagittal diameter of the cord cannot be ascertained. As a result, for practical purposes, the transverse diameter is the only reliable measurement of the cervical spinal cord.

Method and Material

Despite the obvious lack of mathematical exactness, it nevertheless was thought desirable to measure the transverse diameter of the cord and the transverse diameter of the subarachnoid space on spot films taken during routine cervical myelography. All examinations were done in conventional fashion, utilizing a tilt-table equipped with a spot device.

Eighty normal myelograms of the cervical

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region were studied. Of this group of patients 41 were males and 39 were females. The ages ranged from 30 to 70 years. Myelography was performed in these patients primarily for complaints in areas other than the cervical region, such as sciatic or low-back pain. No abnormality in the cervical region was suspected or detected. Cases in which there were unfavorable characteristics, such as osteoarthritic ridging, segmentation of the opaque column or poor visualization of the spinal cord, were excluded.

All measurements were made directly from the spot films and no effort was made to correct for magnification. The table utilized had a target table-top distance of 20 inches and the film in the spot device could be elevated to a maximum of 18 inches above the table-top. It was estimated that in the majority of instances the column of Pantopaque in the mid-cervical region was located about 8 inches above the table-top and that magnification of the spinal cord was between 1.25 and 1.35. No attempt was made to measure the cord at the 1st or 2nd cervical levels and only a limited number of measurements could be made in the upper dorsal region.

The method of determining the measurements is illustrated in Fig. 1. The subarachnoid space shows scalloped lateral contours as the result of the root pouches at each level. The minimal transverse diameter of the column of Pantopaque about midway between the pouches at each vertebral level was marked by crosses and these crosses were connected by straight lines to indicate the lateral limits of the subarachnoid space. At each vertebral segment, the distance between these longitudinal lines was measured at a level at or just below the pouches. The width of the spinal cord was measured at the same level as the transverse diameter of the subarachnoid space. There was little difficulty in identifying the lateral margins of the spinal cord in the films selected for measurement. However, this margin is not as sharply outlined as the subarachnoid space and small errors, up to a millimeter, in the measurement of the transverse diameter of the cord were unavoidable.

Results

As might be expected, there was considerable variation in the transverse diameter of the spinal cord as well as in the ratio of this diameter to the transverse diameter of the subarachnoid space from patient to patient. A representative average curve (Fig. 2A) could be plotted which corresponded in shape rather closely to the usual upper limits of the interpediculate measurements of Elsberg and Dyke (Fig. 2B). In the thoracic region, this relationship does not apply, as the slope of the Elsberg-Dyke curve is considerably steeper.

Values were determined also for the differences between the diameters at adjacent vertebral levels (Fig. 3). These figures in-

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Fig. 1. Spot film taken during the course of cervical myelography. The opaque material has been pooled in the cervical region and the table has been repositioned horizontally. The patient is prone with the head extended moderately. C8-T3 refer to the vertebral bodies. The transverse diameter of the column of Pantopaque narrows slightly between the nerve pouches. These points, marked with crosses, are connected to form longitudinal lines which serve as the lateral boundaries of the subarachnoid space. At each level, a measurement is taken just below the corresponding nerve-root pouches between these lines, e.g. A B at the C6 level. The longitudinal dashed lines indicate the spinal cord. The width of the cord is measured at the same level as the subarachnoid space, e.g., C D at the C5 level.