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Uses of Magnetic Resonance Imaging in Assessing Severity and Forecasting Motor Recovery of Traumatic Spinal Cord Injury

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Uses of Magnetic Resonance Imaging in Assessing Severity and Forecasting Motor Recovery of Traumatic Spinal Cord Injury

In recent years, magnetic resonance imaging (MRI) has gained widespread acceptance as the method of choice for imaging spinal disease and spinal trauma; it is noninvasive and provides more precise and comprehensive imaging. Investigators have shown that MRI can accurately detect spinal cord hemorrhage and edema, and that the proportion of the spinal cord affected by hemorrhage and edema is directly related to the degree of neurologic deficit. While retrospective studies have shown a concordance between MR findings and neurological status, the advantages of MRI for quantifying the severity of spinal cord injury (SCI) and prognosticating outcome has not been established. Such information would have important implications for the initial treatment and optimal rehabilitative management for SCI patients. An improved SCI severity index would assist in the evaluation of the efficacy of alternative therapies for SCI, and, in addition, may help clinicians to prognosticate outcomes more realistically. More realistic expectations for recovery may improve rehabilitative outcomes by facilitating patients' long-term adjustment to SCI.

The purpose of the present study was to develop a method for quantifying the extent of neuroanatomic damage to the cervical spine with MRI, and to demonstrate the relationship between such neuroanatomic damage and long-term motor recovery from SCI.

Methods

Records of 124 adult cases of non-penetrating spinal cord injury admitted to the Regional Spinal Cord Injury Center of the Delaware Valley were examined. Cases were excluded if the MR study could not be located, was unreadable, or did not show pathology. This resulted in a final group of 87 cases. All subjects underwent emergent MRI of the cervical spine following closed reduction of fracture and/or subluxation and prior to surgical stabilization. A neuroradiologist located the longitudinal boundary of the spinal cord hemorrhage and edema relative to the nearest spinal vertebra landmark, from which measures of edema length were generated. Motor index scores for the upper and lower extremities were calculated by adding the right and left scores for each of five muscles, with a possible range of 0-50.

Results

Admission motor scores and scores at one-year follow-up were examined and recovery rates were calculated. At admission, the median upper extremity score was 10.5, and at one-year follow-up, it was 27. The median lower extremity score at both admission and one-year follow-up was 0; many subjects did not show any motor ability. However, the presence of hemorrhage exerted a significant effect on the rate of improvement in motor function for both upper and lower extremity scores. Subjects with hemorrhage had significantly lower motor scores than those without hemorrhage, and showed a lower rate of improvement. Correlational analyses

revealed that outcome was poorer for those subjects with longer edema and for those subjects whose edema affected the upper portions of the cervical spine. Multiple regression analyses revealed that edema length and hemorrhage were independent significant predictors of upper and lower extremity recovery rate, providing explanatory power of 59% and 57%, respectively. The location of the upper edge of the lesion along the cervical spine was not an independent predictor of outcome.

Future work will examine how well MRI predicts functional abilities such as ambulation and ability to perform activities such as eating, dressing and bathing. The sample size will be increased to allow the evaluation of the predictive power of MRI in combination with other factors known to affect outcome from spinal cord injury.

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