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ORIGINAL ARTICLE

AN ANALYTICAL STUDY OF MRI SIGNAL CHANGES AS A PROGNOSTIC PREDICTOR IN PATIENTS UNDEROING CERVICAL CORPECTOMY

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ABSTRACT

Introduction: Cervical Corpectomy is a rewarding surgery for Cervical compressive Myelopathy. Increased signal intensity in T2 weighted MRI indicates significant prognosis. **Materials and Methods:** About 100 patients of cervical compressive myelopathy, who underwent cervical corpectomy, from June 2014 to June 2018 at "The Institute of Neurosurgery, Madras medical College, Chennai, were retrospectively studied. Pre-operative MRI signal changes and post operative functional outcome by Nuricks grade were analysed. **Results**: Increased signal intensity is seen in about 83 patients. T1 weighted MRI signals does not carry significance. Increased signal intensity in T2 weighted MRI is an independent predictor of functional outcome. **Conclusion:** Pre-operative T2 weighted signal changes helps to assess the postsurgical outcome following cervical corpectomy. **Subject Area:** Neurosurgery.

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INTRODUCTION

Increased signal intensity (ISI) within the cervical cord on T2-weighted MR images was note in patients with cervical compressive myelopathy. The significance of ISI has been debated ever since, with conflicting reports of its prognostic value. Many authors have considered ISI within the cervical cord to be a negative prognostic indicator of outcome following decompressive surgery, others have documented no significant influence of these changes on the surgical outcome. The two types of Increased signal Intensity (ISI) changes have been identified: faint, fuzzy changes (Type 1) and intense, sharp changes (Type 2). It has been suggested that the different types of ISI are a result of different pathological entities in the cervical cord. A few studies have looked at the prognostic significance of these different types of ISI. I have studied the predictive value of the type of ISI as an independent factor determining the outcome following Corpectomy in patients with Cervical Compressive Myelopathy (CSM).

MATERIAL AND METHODS

This is a retrospective study of about 100 patients, who underwent Cervical Corpectomy for Cervical spondylotic myelopathy at the Institute of Neurosurgery, Madras Medical College, Chennai, from June 2014 to June 2018.

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There were 90 men (93.9%), and the mean age at surgery was 48.8 ± 0.6years.The median duration of symptoms was 8 months (range 1–180 months), and the mean duration of follow-upwas 35.2 ± 1.9 months. About, 45 patients underwent surgery at 1 level, 52 underwent surgery at 2 levels, and 3 patients underwent a 3-level Corpectomy. Ossification of the posterior longitudinal ligament was identified in about 33 patients.

Categorization of Signal Changes on MR Images

The Sagittal T1- and T2-weighted MR images obtained in all patients were reviewed to determine the presence or absence of signal changes within the cord. Images were obtained using 1.5-Tesla MR imaging units. Categorization of changes on T2-weighted images was based on the sharpness of the margins and the degree of hyperintensity of the intramedullary changes as described by Chen *et al*. Intramedullary signal changes that were dull or light and had an unclear margin were termed "fuzzy" changes or Type 1 changes, and those that were brilliant or intense and were clearly defined were termed "sharp" or Type 2 changes.

Functional Grading and Outcome

All patients were functionally graded preoperatively and at the last follow-up using the Nurick grade. Functional outcome was calculated as Nurick's grade change occurred. To determine the Nurick grade change, the Nurick grade obtained at follow-

up was subtracted from the preoperative Nurick grade. The "Cure" was defined as a followup Nurick grade of 0 or 1.

Statistical Methods

Data were entered into Microsoft Excel software and analyzed using SPSS 17.0 (SPSS, Inc.). Descriptive statistics were used to represent the demographic data. Parametric tests were used to analyze the individual variables with the exception of duration of symptoms, which was not normally distributed, and therefore was analyzed using nonparametric tests. Multiple logistic regression analysis was used to analyze the effects of age, duration of symptoms, preoperative Nurick grade, and ISI change category on the functional outcome. Each factor was converted into a categorical variable for regression analysis. Mean values are expressed as ± standard error.

RESULTS

The mean preoperative Nurick grade was 3.3 ± 0.06, and the postoperative Nurick grade was 1.9 ± 0.07 ($p < 0.001$).

Prevalence of ISI Changes

Increased signal intensity changes were found in about 83 patients (84.8%). Type 1 ISI was seen in about 52 patients (52.8%), and Type 2 ISI was seen in about 32 patients (32.0%).There was no significant difference in the preoperative variables between the ISI groups.

Effect of T2-Weighted ISI on Outcome

Nurick grade change and follow-up Nurick grade in patients with Type 2 ISI were not significantly different from those of patients with Type 1 and Type 0 ISI. Also, the presence of Type 1 ISI was not associated with significantly different functional outcomes compared with patients with no ISI in terms of follow-up Nurick grade ($p = 0.10$) and change in Nurick grade ($p = 0.31$).

Effect of T1-Weighted Hypointensity

All patients with hypointensity on T1-weighted images (about 8 patients) had Type 2 T2-weighted ISI. There was no statistically significant difference between patients with hypointensity on T1-weighted images and those with only Type 2 ISI on T2-weighted images (23 patients)with regard to age ($p = 0.25$), duration of symptoms ($p = 0.84$), preoperative Nurick grade ($p = 0.95$), and change in Nurick grade ($p = 0.28$). The follow-up Nurick grade was also not significantly worse in these patients (2.2 vs1.9; $p = 0.26$).

Factors Affecting Outcome

Multilevel logistic regression was used to identify the predictors of Nurick grade change ≥ 1 and patients in whom there was a cure. I have found that the age of 40years or younger (38 patients) was the only significant independent predictor of Nurick grade change ≥ 1 (OR 3.1, 95% CI 1.07–13.1; $p = 0.03$), while the factors affecting the probability of cure were a preoperative Nurick grade of 4 or 5 (OR 0.23, 95% CI 0.1–0.4; $p < 0.001$) and the presence of Type 2 ISI on T2-weighted preoperative MRimages (OR 0.48, 95% CI 0.2–0.9; $p = 0.04$) . Patients with Nurick Grades 4 and 5 (39 patients) were older (51.9 vs 46.7 years; $p < 0.001$) and had worse followupgrades (2.5 vs 1.5; $p < 0.001$) than patients with better preoperative Nurick grades (Grades 1–3) (58 patients). Regression analysis using Type 1 ISI on T2-weighted images as a variable showed that a fuzzy change was not associated with either improvement in Nurick grade (OR= 0.7, 95% CI = 0.3–1.5; $p = 0.41$) or cure (OR 1.4, 95% CI 0.7–2.7; $p = 0.23$). In other words, the presence of Type 1 ISI was not an independent predictor of outcome. Logistic regression was performed for patients with Type 2 ISI (31 patients) using age, reoperative Nurick grade, duration of symptoms, and presence of T1-weighted hypointensity as predictive factors. The presence of T1-weighted hypointensity was the only variable that significantly affected the probability of cure (OR 0.1, 95% CI 0.01–0.9; $p = 0.04$) in this group.

DISCUSSION

Predictors of Outcome: The availability of strong predictors of outcome following decompressive surgery in patients with CSM will enable the patient and the surgeon to recognize the prognosis after surgery. Age, duration of symptoms, transverse compression ratio of the cord on MR images, ISI, sagittal alignment of the cervical spine, and preoperative functional status of the patient are among the factors that have been studied for their influence on outcome after decompressive surgery for CSM. Age, duration of symptoms, and preoperative functional status have been found to independently affect the outcome after decompressive surgery in the majority of reports. Therefore, the effect of any other variable, such as ISI, on outcome can only be studied when these factors are controlled for. Previously, authors have used JOA (Japanese Orthopedic Association) recovery rate to quantify the surgical outcome. In this study, since I have used the Nurick grade, the factors that affect the outcomes are better related to the neurological outcome as assessed by the Nurick grade. However, we were able to use a definite functional status as defined by cure (Nurick Grade 0 or 1). Also, by using cure as an outcome measure in the present study, we were able to look at the best possible result (as measured by the Nurick grade) after surgery and the effect of MR imaging changes on this outcome. I found that age was a significant predictor for improvement in Nurick grade and that younger patients had a higher probability of improvement of Nurick grade after surgery. However, age at surgery was not an independent factor predicting cure at follow-up. The preoperative functional status and presence of Type 2 ISI on T2-weighted images were found to significantly influence the odds of cure after surgery. Poor neurological function preoperatively has a definite negative impact on the functional outcome after anterior decompressive surgery for Cervical compressive myelopathy. In this series, a preoperative Nurick grade of 4 or 5 emerged as an independent factor responsible for reducing the probability of cure after surgery. While patients with poor grades do certainly improve in their functional status and therefore warrant surgical intervention, they should be advised not to expect near-normal activity after surgery.

Type of ISI Change and Outcome

Chen *et al*. 4 reported on 2 types of ISI on T2-weighted MR images obtained in 64 patients who underwent cervical decompression for CSM. The fuzzy, or Type1, ISI is thought to be representative of reversible cord changes, and the sharp, or Type 2, ISI is thought to be related to cavitation and therefore is not reversed after surgery. Consequently, Chen *et*

al. found that patients with Type 1 ISI have a prognosis similar to those with no ISI, and those with Type 2 ISI have a poorer outcome after surgery than those with no change, or Type 1 ISI. Yukawa *et al*. prospectively studied the predictive value of the type of ISI in 104 patients who underwent cervical laminoplasty for different types of cervical cord compression, mainly CSM or OPLL. Similar to the findings of Chen *et al*., 4 they also found that patients with intense ISI (Type 2) had the worst outcome following surgery. However, patients with ISI were older and had a longer duration of symptoms than those with no ISI. Therefore, in the study reported by Yukawa *et al*., it is unclear whether the type of ISI was an independent predictor of outcome. Shin *et al*. described similar results in 70 patients who underwent ACDF and showed that severity of ISI and preoperative neurological status were the most important prognostic factors in patients with disc prolapse. However, there was a significant difference in the preoperative JOA score in their series, with high-grade ISI patients having a worse score. Avadhani *et al*.2 described the types of T2-weighted ISI in 35 patients with CSM and found no significant difference in the recovery ratios between Types 1 and 2 ISI. However, the authors did not control for any variables when studying the prognostic significance. In this study, I have studied only the patients undergoing anterior decompressive surgery for CSM and all patients underwent the same surgery. Therefore, the role of the surgery as a variable affecting the outcome is minimal, and the true effect of other factors becomes apparent. Moreover, since the preoperative variables were similar between the ISI groups, the results of the regression analysis are more likely to be accurate. While initial reports showed that the presence of T2-weighted ISI indicates poor outcome, it seems essential to further categorize the type of T2-weighted ISI before establishing prognostic significance. Previous studies in addition to ours have shown that, although Type 1 ISI is the commonest MR imaging change in patients with CSM, it does not predict poor outcome. Type 1 ISI appears to be an indicator of milder cord injury, and Chen *et al*.4 have shown that Type 1 ISI is more likely to reverse after surgery compared with Type2 ISI. Overall, Type 1 ISI on T2-weighted MR images is common in patients with CSM, but its role as an independent predictor of outcome is minimal. The proportion of patients with Type 2 ISI is similar in 3 of the 4 studies alluded to above and in our study. About one-third of patients with CSM or OPLL seem to have Type 2 ISI on their MR images. Avadhani *et al*. 2 showed a 60% prevalence of Type 2 ISI, which is not reflected previously in the literature (Table 4). In this study, we found that Type 2 ISI has a negative influence on the likelihood of cure, and hence the identification of a sharp change on preoperative MR images offers prognostic significance and precludes an ideal neurological outcome as measured by the Nurick grade.

Changes on T1-Weighted Images and Outcome

To improve the prognostic value of the intramedullary signal changes on MR images in the cord, some authors have tried to combine these with the changes on T1-weighted images. Morio *et al*.14 found that in 73 patients with CSM, 4 had low T1-weighted/high T2-weighted signal and these patients had the worst outcomes. Avadhani *et al*.2 and Fernández de Rota *et al*.7 reported a 14.2% prevalence of T1-weighted hypointensity among patients with T2-weighted ISI, while Chen *et al*.4 found that only 1 of the 44 patients with Type 2 ISI had T1-weighted hypointensity. Shin *et al*. 21 and Yukawa *et al*.28 did not report the incidence of T1-weighted hypointensity in their series. In contrast to the experience of these authors, Suri*et al*. 22 and Mastronardi *et al*.10 reported that more than 60% of the patients with ISI on T2-weighted images had T1-weighted hypointensity and that these patients had poorer outcomes. In our series, 16 (25.3%) of 63 patients with Type 2 ISI had T1-weighted hypointensity, which is in keeping with earlier studies that showed a low prevalence of T1-weighted changes in patients with CSM. The absence of T1-weighted hypointensity was found to be the only independent predictor of cure ($p = 0.04$) in patients with Type 2 ISI. The prognostic value of T1-weighted hypointensity has been confirmed in previous studies that have used regression analysis. Hence, while patients with Type 2 ISI already have a poor chance of cure, the additional presence of T1-weighted hypointensity further worsens the prognosis, suggesting more severe pathological changes in the cord.

Pathological Correlates of ISI

It is postulated that ISI represents a wide spectrum of pathological changes within the cord that result from chronic compression and ischemia as a consequence of spondylotic changes in the cervical spine. The changes in the cord causing ISI can range from edema, demyelination, and ischemia to gliosis, microcavitation, and frank syringomyelia. While the former changes are presumed to be reversible with decompressive surgery, the latter are unlikely to improve with surgery. Autopsy studies by Ohshio *et al*. examined the correlation between MR imaging changes and pathology in spinal cords of patients with chronic cord compression and confirmed that a wide range of pathological changes in the cord appear as ISI on MR images. Since the presence of Type 2 ISI significantly reduces the possibility of cure after surgery, it is likely that this represents serious cord damage and prevents complete recovery.

Study Limitations

Limitations of this study include its retrospective nature. The other concern is the fact that sagittal images are typically used to classify ISI. The transverse extent of the cord that is involved by the pathological changes and the location of the changes (central gray or the lateral or posterior white columns) are not studied. Conversely, the strengths of this study include the patient population, who underwent the same surgical procedure with a relatively long mean follow-up period of nearly 3 years. The multivariate analysis used by us eliminated the confounding effect of variable symptom duration and ages of the patients. This has allowed me to determine the impact of the type of T2- weighted changes as an independent predictor of outcome following decompressive surgery.

Conclusion

In this study, I have sought to identify the predictive value of the type of signal change seen on preoperative MR images and the relationship between signal change and functional outcome (as measured by the Nurick grade) of patients undergoing Corpectomy for cervical degenerative myelopathy. Increased signal intensity changes on T2-weighted images were seen in more than 80% of the 100 patients with CSM, and the majority of the patients had Type 1 T2-weighted ISI. Type 2 T2-weighted ISI on preoperative MR images predicted a decreased likelihood of cure in patients with CSM or OPLL. Hypointensity on T1-weighted images was seen in 16 patients

in association with Type 2 T2-weighted ISI change and was found to negatively impact the probability of cure.

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REFERENCES

Bucciero A, Vizioli L, Carangelo B, Tedeschi G: MR signalenhancement in cervical spondylotic myelopathy. Correlationwith surgical results in 35 cases. *J Neurosurg Sc*i 37:217–

Chen CJ, Lyu RK, Lee ST, Wong YC, Wang LJ: Intramedullaryhigh signal intensity on T2-weighted MR images incervical spondylotic myelopathy: prediction of prognosis with type of intensity. *Radiology* 221:789–794, 2001

Emery SE, Bohlman HH, Bolesta MJ, Jones PK: Anterior cervicaldecompression and arthrodesis for the treatment of cervicalspondylotic myelopathy. Two to seventeen-year followup. *J Bone Joint Surg Am*., 80:941–951, 1998

Fernández de Rota JJ, Meschian S, Fernández de Rota A, Urbano V, Baron M: 2007. Cervical spondylotic myelopathy dueto chronic compression: the role of signal intensity changes in magnetic resonance images. *J Neurosurg Spine* 6:17–22.

Houten JK, Cooper PR: Laminectomy and posterior cervicalplating for multilevel cervical spondylotic myelopathy andossification of the posterior longitudinal ligament: effects on cervical alignment, spinal cord compression, and neurologicaloutcome. Neurosurgery 52:1081–1088, 2003

Matsuda Y, Miyazaki K, Tada K, Yasuda A, Nakayama T, MurakamiH, *et al*: Increased R signal intensity due to cervicalmyelopathy. Analysis of 29 surgical cases. *J Neurosurg.,* 74: 887–892, 1991

Predictability of operative results of cervical compressionmyelopathy based on preoperative computed tomographic myelography. Spine (Phila Pa 1976) 18:1958–1963, 1993

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