

## Role of Metabolites in Biofluids as a Prognostic Indicator of Neurological Recovery in Acute Spinal Cord Injury

*Alka Singh, MSc; Rajeshwar Nath Srivastava, MS; Saloni Raj, MPH  
King George's Medical University, Lucknow, UP, Lucknow, INDIA*

**Purpose:** Acute spinal cord injury (ASCI) is still having substantial morbidity and mortality despite advanced therapeutics. Major obstacles are paucity of monitoring tools or biomarkers for severity determination, recovery, and prognostication. A prospective case-control pilot study with serum <sup>1</sup>H NMR (nuclear magnetic resonance) spectroscopic metabolic profiling was carried out to evaluate metabolites perturbations and their relationship with recovery and to see role of stem cells in facilitating neurological recovery.

**Methods:** A total of 135 subjects were enrolled in the study. 65 ASCI subjects were divided into 2 groups: fixation alone (FA, n = 34) and fixation with stem cell therapy (FST, n = 31). 70 healthy control subjects (HCs) were enrolled. Serum and urine samples were collected at admission (baseline), 6th week, 3rd month, and after 6th month (follow-up). NMR data of serum and urine sample were quantified and subjected to multivariate analysis using supervised OSC (orthogonal signal correction)-PCA (principal component analysis) followed by OPLS-DA (orthogonal projections to latent structures discriminant analysis) was performed in the full study. This finding was further validated in the VIP (visual infusion phlebitis) scores.

**Results:** In this study 135 participants were enrolled. In FST group, 61.29% subjects remained in AIS (Abbreviated Injury Scale) A and the percentage improvements to AIS B, C, and D were 12.90%, 16.13%, and 9.68%, respectively, whereas in FA group these values were 67.65%, 17.64%, 11.76%, and 2.94%, respectively. At the 6-month follow-up, improvements in sensory and motor scores were observed in both cases groups, but FST group showed better result. In the spectra of urine biofluid, 43 metabolites were identified and assigned and 28 metabolites were identified and assigned in serum biofluid. An OSC-PCA and OPLS-DA model was created for investigating the role of metabolites in differentiation amid all ASCI subjects against healthy controls at baseline as well as at final follow-up. Statistical comparison was validated by OSC-PCA as well as OPLS-DA methods and multivariate data analysis resulted in R<sup>2</sup> values of 0.91 and 0.81 and Q<sup>2</sup> values of 0.81 and 0.67, respectively. The generated model was robust enough for evaluating the differentiation among the present data set. The 3-dimensional (3D) OSC-PCA model generated resulted in the total explained variance of 50.21% and 50.67%, respectively. The 3D scattered score plots represented the shifting of more ASCI subjects towards healthy controls in the final follow-up, which is suggestive of improved health status and an indicator of better prognosis in ASCI subjects.

**Conclusion:** Serum and urine NMR spectroscopy reveals certain metabolites perturbations having clear correlation with pattern of recovery in treated ASCI subjects. Stem cell treatment group had comparatively effective recovery.