Use of artificial neural networks to decision making in patients with lumbar spinal canal stenosis

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AIM: A lack of consensus exists regarding indications for surgery for lumbar spinal canal stenosis (LSCS). Hence, the aim of this study is to develop an artificial neural network (ANN) model that is designed to accurately select patients for surgery or non--surgical options and to compare such with the traditional clinical decision making approach in LSCS patients.
METHODS: An ANN model and a logistic regression (LR) model were used as predicting models. The data for a total of 346 of 379 patients (143 male, 203 female, mean age 59.5±11.5 years) were available for the analysis. The measured metrics included visual analog scale (VAS) of leg pain/numbness, the Japanese Orthopaedic Association (JOA) Score, the Neurogenic Claudication Outcome Score (NCOS), the Oswestry disability index (ODI), the Swiss Spinal Stenosis Score (SSS), the stenosis bothersomeness index (SBI), the dural sac cross-sectional surface area (DSCA), the Stenosis Ratio (SR), the Self-Paced Walking Test (SPWT), morphology grade presented by Schizas et al. and grading system introduced by Lee et al. Successful outcome was recorded based on the criteria presented by Stucki et al. Twelve measures and age, gender, and duration of symptoms, were recorded as the input variables for the ANN and LR, and the ANN was fed with patients. A sensitivity analysis was applied to the developed ANN model to identify the important variables. Receiver operating characteristic (ROC) analysis, Hosmer-Lemeshow (H-L) statistics and accuracy rate were calculated for evaluating the two models. The study was not supported by a grant and the authors declare that they have no conflict of interest.
RESULTS: The patient information was divided into training (n = 174), testing (n = 86), and validation (n = 86) data sets. Successful outcome were achieved in 93.4% of the patients selected for surgery and 89.4% for non-surgery at 1-year follow-up. The SR, morphology grade and grading system were important variables identified by the ANN. The ANN model displayed better accuracy rate (97.8 %), a better H-L statistic (41.1 %) which represented a good-fit calibration, and a better AUC (89.0%), compared to the LR model.
CONCLUSIONS: The findings showed that an ANN model can predict the optimal treatment choice for LSCS patients in clinical setting and is superior to LR model. Our results will need to be confirmed with external validation studies.

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