1212

Elucidating Factors Influencing Machine Learning Algorithm Prediction in Spasticity Assessment: A Prospective Cross Sectional Observational Study

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Objective: To train and validate a machine learning model (MLM) algorithm utilizing the inertial and sEMG datasets for spasticity assessment according to MAS classification and determine the trained and validated MLM algorithm's prediction performance in predicting ambiguous spasticity datasets.

Background: The MLM has garnered popularity in rehabilitation, ranging from developing algorithms in outcome prediction, prognostication, and training artificial intelligence to measure the rehabilitation interventions' effectiveness. High-quality data plays a critical role in algorithm development. Biases and variances have been described as one of the challenges in ensuring high-quality data. However, limited studies have explored factors that may influence the MLM algorithm performance in predicting spasticity severity level.

Methods: It is a prospective cross-sectional observational study. Forty-seven persons diagnosed with central nervous system pathology who underwent inpatient and outpatient rehabilitation clinic that fulfilled the inclusion and exclusion criteria were recruited. The Modified Ashworth Scale (MAS) classification of elbow flexors was evaluated by two experienced assessors, a rehabilitation physician, and a physiotherapist. Four biomechanical properties of spasticity were obtained using off-the-shelf wearable sensors. The data were analyzed individually, and ambiguous datasets for each MAS level classification were isolated and separated. The acceptable data of angle [degree], resistance force [newton], and surface electromyography [voltage] were included for the training and validating machine learning-based model (MLM) of MAS score. The trained and validated MLM algorithm was later deployed to predict the ambiguous spasticity datasets' MAS score.

Results: A series of MLM were applied, including Support Vector Machine, Decision Tree, and Random Forest. The validated MLM's performance accuracy was 96%, 52%, and 72%, respectively. The validated MLM accuracy performance level predicting ambiguous spasticity datasets reduces to 20%, 23%, and 23%, respectively. The low prediction performance are MAS 0, MAS1+, MAS 2, and MAS 3.

Conclusions: This study elucidates data biases and variances that limits the MLM algorithm in predicting spasticity data. Background diseases, pathophysiological and anatomical factors have to be considered to interpret individual data.

1213

Pyramidal pathway changes at conventional brain 3T-MRI in patients with hereditary spastic paraplegia

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Objective: Our aim was to evaluate the occurrence of motor cortex (MC) and cortico-spinal tract (CST) magnetic resonance imaging abnormalities in patients with hereditary spastic paraplegia (HSP).

Background: Conventional MRI can identify abnormalities associated with upper motor neuron (UMN) involvement. MC and CST imaging abnormalities are reported in patients with amyotrophic lateral sclerosis (ALS), but their prevalence in other disease with UMN involvement such as HSP is poorly studied.

Methods: We retrospectively evaluated 3T-MRI from 44 HSP patients (27 men, mean age 49.3 ± 14.6), 55 ALS patients (35 men, 56.3 ± 7.6) and 52 controls (34 men, 53.4 ± 5.1). Features of interest were CCS T2/FLAIR hyperintensity, MC SWI hypointensity and selective MC atrophy. Differences among groups were tested using $\chi 2$ or ANOVA based on data ($p < 0.05$). We adjusted the analysis for age using logistic regression.

Results: HSP patients had more frequently CCS FLAIR hyperintensity than controls but less than ALS patients (HSP 40.5%, ALS 67.3%, controls 30%; p<0.001). The prevalence of MC SWI hypointensity (HSP 69.2%, ALS 73.5%, controls 18.8%; p<0.001) and atrophy (HSP 73.8%, ALS 64.2%, controls 42.3%; p<0.01) was similar in HSP and ALS patients, both higher than in controls. The results did not change adjusting for age.

Conclusions: The prevalence of MC and CCS MRI abnormalities in HSP patients is higher than controls. However, it was similar to ALS patients, except for CCS FLAIR hyperintensity. less frequent in HSP, possibly reflecting pathophysiological differences. The finding of such MRI features supports a pyramidal involvement but is not able to discriminate between HSP and ALS.

1214

Studying of the correlation between the severity of ischemic stroke and the severity of post-stroke spasticity in the early recovery period

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Objective: The objective was to identify the correlation between the severity of the ischemic stroke and the severity of post-stroke spasticity in the early recovery period.

Background: Spasticity is a movement disorder that is one of the main disabling symptoms in patients with ischemic stroke. Spasticity significantly limits everyday activity and decreases the life quality of patients.

Methods: We included 36 patients (19 females, 67 ± 9 years old, and 17 males, 62 ± 5 years old) who suffered an ischemic stroke. The severity of the stroke was evaluated on admission using the National Institutes of Health Stroke Scale (NIHSS), and the severity of the spasticity was evaluated in the early recovery period using the Modified Ashworth Scale (MAS).

Results: Three months after the stroke, spasticity was revealed in only 19% of patients. At the same time, 43% of them had spasticity in only one limb, and 57% of them had spasticity in two limbs. Among patients with spasticity in one limb, 66% were evaluated as minor stroke, 34% as moderate stroke, and the severity of their spasticity was rated as Score 1+ and Score 2, respectively. Among patients with spasticity of two limbs, 50% were evaluated as moderate stroke, 25% as severe-to-moderate stroke, 25% as severe stroke, and the severity of their spasticity was rated as Score 2, Score 3, and Score 4, respectively.

Conclusions: Despite the small number of patients included in the study, there is a certain relationship between the severity of the stroke and the severity of spasticity in the early recovery period: the more severe the stroke, the more severe the spasticity. However, this issue requires more comprehensive study in the future.

Surgical Therapy: Other Movement Disorders

1215

Role of the Stereotactic Dentatotomy for the management of Movement Disorders

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Objective: Evaluate the antecedents about the clinical outcomes of stereotactic dentatotomy in the management of diverse motor disorders.

Background: The dentatotomy is a surgical technique that consists in the ablation of the dentate nucleus, it was performed for the first time in 1935 by Delmas-Marsalet, having popularity in the 70's years for the management of motor disorders and later abandoned for more of 3 decades for its variable results and the arrival of new surgical techniques.

Methods: An advanced search in Pub Med was carried out using Mesh terms; "Cerebellar Nuclei" as Major Topic and "Surgery" as subtopic, obtaining a total of 37 results. Data extraction was focused on collecting the clinical outcomes of individuals with various types of motor disorders undergoing stereotactic dentatotomy. Descriptive statistics were used for

Table 1 Results of ablations in the DN for the management of motor disorders.

Author & Year	Spasticity (n =)	Clinical Condition	Spasticity Improvement n	%
[1] Nashold (1969)	1	S, T, A.	1	100%
[2] Heimburger RF (1970)	27	S, D. T, A.	11	40.74%
[3] Nadvornik (1972)	5	S, M.	5	100%
[4] Hitchcock (1973)	8	S	4	50%
[5] Siegfried and Verdie (1977)	50	S	16	32%
[6] Texeira (2015)	10	S, D.	5	50%
[7] Hanuska (2020)	1	S	1	100%
	102		43	**42.15%**

S: Spasticity/Rigidity, D: Dystonia, T: Tremor, A: Athetosis, M: Myoclonus.