Objective：Various automatic algorithms have been developed in recent years to accelerate sleep scoring and to reduce human efforts in rodent models. Nonetheless, even for those showing excellent performance, no algorithm has been validated on different strains of rodent. The applicability of such system in genetic modified animal models was therefore unclear. The aim of this study is to develop an automatic sleep analysis scoring algorithm using supervised and unsupervised approaches to discriminate between normotensive Wistar-Kyoto rats (WKY) and spontaneously hypertensive rats (SHR).

Methods: Polysomnographic analysis was performed on freely moving WKY and SHR under full day monitoring. Continuous power spectral analysis was applied to the electroencephalogram (EEG) and electromyogram (EMG) signals, from which the mean power frequency (MPF) of the EEG and the power magnitude of the EMG (EMG power) were quantified. Automatic scoring algorithm was developed using rule-based, clustering method and the support vector machine (SVM). Rats consciousness states were discriminated into active waking (AW), paradoxical sleep (PS), and quiet sleep (QS). Hypnograms constructed by each method were compared with manual scoring outcome to assess accuracy. Moreover, SHR are reported to have more fragmented sleep architecture pattern in comparison with WKY. Inter-phasal transitions were quantified upon the two strains to assess the applicability on strain discrimination.

Results：MPF and EMG power thresholds for rule-based scoring algorithm determined using different frequency bands of encephalogram and one-dimensional clustering method showed decent performance on the accuracy among the WKY rats and the SHR rats (85%-87%). Two-dimensional clustering (K means) implemented as unsupervised machine learning method presented 85% accuracy for the WKY rats and 70% accuracy for the SHR rats. Notably, Two-dimensional clustering method showed the best sensitivity for paradoxical sleep on both strain (70%-75%). Support vector machine exhibited the best performance with 94% accuracy for the WKY rats and 93% accuracy for the SHR rats. Sleep phase alternation counts quantified by all the above methods showed significant difference among WKY rats and SHR rats ($p<0.05$).

Conclusion：Unsupervised machine learning algorithm using SVM resulted in the best performance among all other approaches. The sleep architectural pattern of the SHR rats revealed to be fragmented and can be easily identified compared to the WKY rats using automatic scoring algorithms.

中文題目：全自動大鼠判期程式設計並應用於分辨 WKY 與 SHR

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