Validation of a periodic leg movements scoring algorithm in a commercial available custom polysomnography system against manual scoring

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Background

- Periodic leg movements (PLM) during sleep (PLMS) are present in >80 % of patients with restless legs syndrome (RLS), but can also be present in other sleep-related or neurological disorders as well as in healthy subjects.
- Softwares for automatic analysis of PLMS have been developed, but only few of them have been validated.

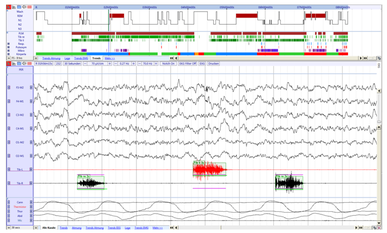
Aim

Aim of this study was to validate a PLM analysis algorithm integrated in a polysomnography (PSG) system against manual scoring, which could be useful not only for clinical but also for research purposes.

Methods

- Routine PSG report of the Sleep Disorders Unit, Innsbruck Medical University, were screened to find 20 patients with RLS - diagnosed according to the International RLS Study Group (IRLSSG) criteria[1] - with an automatic-scored PLMS index higher than 20/h.
- 20 control subjects were selected among patients undergoing PSG for other reasons, without RLS and with an automatic-scored PLMS index ≤ 5/h.
- For both groups, exclusion criteria were an apnea-hypopnea index (AHI) >5/h or the use of a continuous positive airway pressure (CPAP) therapy.
- All participants underwent video-PSG according to the American Academy of Sleep Medicine (AASM) standards.[2]
- Manually and computerized scoring of PLM was performed according to AASM criteria.[2] PLMS and PLM during wakefulness (PLMW) indices, intermovement intervals (IMI) for PLMS during NREM, REM and total sleep, and for PLMW were manually and automatically scored.
- The computerized software algorithm for detection and analysis of periodic leg movements is a feature of the Brain RT PSG system by OSG (http://www.osg.be).
- An event per event analysis was performed for each LM. Sensitivity and false positive rate were calculated.

A



B

A. Settings for the computerized detection and analysis of PLM.

B. Example of computerized detection of PLM. Leg movements are marked with green rectangles, and periodic leg movements with underlining pink bars. An overview of the PLM during the whole night is visible in the upper part of the figure, where PLM are shown as red bars.

Results

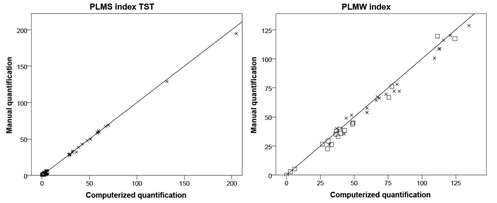
- 20 patients with RLS (14 men, 6 women) with a median age of 51.5 (37-73) years were included.
- The control group included 13 men and 7 women with a median age of 32 (20-60) years.
- A total of 10,269 PLM (median 172.5/subject, range 8-979/subject) were manually scored, 6,731 PLMS (median 76.5/subject, range 1-910/subject) and 3,538 PLMW (median 44/subject, range 0-547/subject).

Manual vs computerized analysis of PLM

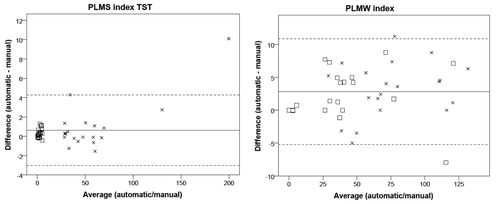
	Manual quantification	Computerized quantification	Interclass correlation coefficient	P values
PLM index				
PLMS/h, TST	16.5 (0.2-194.6)	16.6 (0.2-204.7)	0.999 (0.998-0.999)	**<0.001***
PLMS/h, NREM sleep	16.9 (0-195)	17.5 (0-205.2)	0.999 (0.998-0.999)	**<0.001***
PLMS/h, REM sleep	4.4 (0-172.5)	4.4 (0-195)	0.994 (0.989-0.994)	**<0.001***
PLMW	50.2 (0-128.5)	49 (0-134.8)	0.991 (0.965-0.996)	**<0.001***
Intermovement interval				
TST, sec	32.8 (17.2-59.8)	34.9 (17.2-61.3)	0.945 (0.886-0.973)	**<0.001***
NREM sleep, sec	35 (17.4-59.8)	34.5 (17-61.3)	0.878 (0.778-0.875)	**<0.001***
REM sleep, sec	28.9 (15.5-62.6)	29.1 (16.2-55.2)	0.831 (0.659-0.921)	**<0.001***
Wakefulness, sec	25.4 (14.7-35.3)	22.9 (16.3-34.7)	0.779 (0.617-0.877)	**<0.001***

All values calculated by manual and computerized analysis were very similar (Spearman correlation coefficients between 0.751 and 0.996, interclass correlation coefficients between 0.775 and 0.999). The event per event analysis showed a good agreement between the two methods (sensitivity 97%, false positive 1% for PLMS in TST).

Correlations



Bland-Altman plots



Single values for patients are represented as crosses, for controls as squares.

In the Bland-Altman plots, the horizontal lines represent mean ± 2 SD

Conclusions

- The current study validated a software algorithm for the detection and analysis of PLM integrated in a PSG system and commercially available against the gold standard visual detection and manual scoring according to AASM criteria, showing excellent agreement between both methods.
- The possibility to calculate several indices suggest that time-saving computerized PLM scoring is an excellent tool, useful not only in the clinical practice but also for research purposes.

References

1. Allen RP, Picchietti DL, Garcia-Borreguero D, et al. Restless legs syndrome/Willis-Ekbom disease diagnostic criteria: updated International Restless Legs Syndrome Study Group (IRLSSG) consensus criteria--history, rationale, description, and significance. Sleep Med 2014;15:860-73.
2. Berry RB, Brooks R, Gamaldo CE, Harding SM, Marcus CL and Vaughn BV for the American Academy of Sleep Medicine. The AASM manual for the scoring of sleep and associated events: rules, terminology and technical specifications, Version 2, Darien, Illinois: AASM, 2012.

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