Visual Analysis of the EEG Performs Better than Standard Spectral Analysis in the Clinical Setting

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Background and Aims

The electroencephalogram (EEG) provides objective information useful for detecting and monitoring hepatic encephalopathy (HE); its acquisition does not require patient co-operation and there are no learning effects. The ISHEN guideline (Guérit et al 2009) states that '*the EEG classification based on visual pattern recognition, although informative, does not allow reliable grading'* and that '*quantitative (computer-based) analysis may improve the reliability of EEG assessment*'. However, this recommendation was rated as weak and uncertain. This study aims to compare the performance of visual and spectral analysis of the EEG for the diagnosis of any degree of HE.

Methods

The study population comprised of 137 healthy controls (53% men: mean [range] age 39 [17–75] yr) and 226 patients with cirrhosis (66% men; mean age 54.8 [26–80] yr) classified, based on clinical status and PHES results, as neuropsychologically unimpaired (n=127) or as having minimal (n=21) or overt (n=78) HE. A researcher with no previous experience received basic training in EEG analysis. She was asked to select 60 to 100 sec of recording, preferably from the P3-P4 montage, from the 403 anonymized patient/control EEG records and to estimate the visual wave frequency in a representative epoch, marking her selection. Spectral analysis of the EEG was undertaken on the same 60 to 100 sec of recording and the mean dominant frequency (MDF) and %theta power obtained (Jackson *et al,* 2016). The performances of the visual and spectral assessment of the EEG for the diagnosis of any degree of HE were compared.

Results

The diagnostic performance for the diagnosis of any degree of HE was comparable between the visual assessment of background activity (ROC: threshold 8.75 Hz; AUC 0.84; sensitivity 77.4%; specificity 74.5%) and the spectral %theta power (ROC: threshold 23%; AUC 0.81; sensitivity 74.8%; specificity 78.4%). However, the visually assessed background activity provided better separation of the patients in relation to their neuropsychiatric status that either of the spectral variable. Thus, significant differences were observed in the visual background activity between all patient groups and healthy controls and between patients with minimal and overt HE, whereas significant differences in spectral variables were only observed in the patients with overt HE (Figure 1).

Conclusion

The ISHEN statement that 'visual assessment of the EEG, does not allow reliable grading' and that 'quantitative analysis may improve the reliability of EEG assessment is not supported by the findings in this study.

Figure 1: Visual *vs*. spectral analysis of the EEG in HE