Evaluation of the Edinburgh Motor Assessment (EMAS)

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1. Introduction

The Edinburgh Motor Assessment (EMAS) was introduced in 2013 at the Anne Rowling Clinic in Edinburgh as a brief motor screening tool to assess motor dysfunction in dementia patients. It consists of 33 items, which are rated on a scale of 0 (no impairment) to 3 (significant impairment), and assigned to 1 of 4 motor domains (extrapyramidal, amyotrophic, cerebellar, or complex). EMAS is scored out of 99 points and on the basis of the distribution of data in normal controls an abnormal score is defined as a score higher than 14. On average EMAS takes 6 min to complete in clinical practice, and it has been carried out for 226 patients.

2. Why we need EMAS

(a) Specialist consultants provide information on motor performance significantly more often than GPs and other doctors. (b) In >50% of cases where the referral letter indicated no motor impairment, there was significant motor impairment according to EMAS (score > 14). Note that all EMAS were carried out within 6 months of the referral (n=48).

3. Validation of EMAS

1. Do the 33 items measure the same underlying construct, i.e. motor ability? Internal consistency was assessed using all EMASes (n=364) Cronbach’s α = 0.92

2. How good is the agreement between raters? Inter-rater reliability was assessed using scores from two different raters (n=91) for each item & the total EMAS score. For items: average krippendorff’s α = 0.62

For EMAS total score: p = 0.911 **

4. Dimensionality of EMAS

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor Loadings</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
<th>Factor 5</th>
<th>Communalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivy park</td>
<td>0.255</td>
<td>0.130</td>
<td>0.314</td>
<td>0.071</td>
<td>0.331</td>
<td>0.330</td>
<td>0.715</td>
</tr>
<tr>
<td>with apraxia</td>
<td>0.255</td>
<td>0.130</td>
<td>0.314</td>
<td>0.071</td>
<td>0.331</td>
<td>0.330</td>
<td>0.715</td>
</tr>
<tr>
<td>Horizontation/ supination</td>
<td>0.209</td>
<td>0.107</td>
<td>0.103</td>
<td>0.117</td>
<td>0.297</td>
<td>0.579</td>
<td>0.730</td>
</tr>
<tr>
<td>Ataxia tests</td>
<td>0.209</td>
<td>0.107</td>
<td>0.103</td>
<td>0.117</td>
<td>0.297</td>
<td>0.579</td>
<td>0.730</td>
</tr>
<tr>
<td>Finger movements</td>
<td>0.272</td>
<td>0.346</td>
<td>0.252</td>
<td>0.103</td>
<td>0.064</td>
<td>0.087</td>
<td>0.487</td>
</tr>
<tr>
<td>Leg movements</td>
<td>0.209</td>
<td>0.107</td>
<td>0.103</td>
<td>0.117</td>
<td>0.297</td>
<td>0.579</td>
<td>0.730</td>
</tr>
<tr>
<td>Rigidity</td>
<td>0.332</td>
<td>0.172</td>
<td>0.190</td>
<td>0.205</td>
<td>0.283</td>
<td>0.310</td>
<td>0.548</td>
</tr>
<tr>
<td>Dystonia</td>
<td>0.357</td>
<td>0.272</td>
<td>0.310</td>
<td>0.205</td>
<td>0.283</td>
<td>0.310</td>
<td>0.548</td>
</tr>
<tr>
<td>Voluntary limb movements</td>
<td>0.433</td>
<td>0.190</td>
<td>0.283</td>
<td>0.310</td>
<td>0.283</td>
<td>0.310</td>
<td>0.548</td>
</tr>
<tr>
<td>Slowing mouth-tongue</td>
<td>0.380</td>
<td>0.190</td>
<td>0.283</td>
<td>0.310</td>
<td>0.283</td>
<td>0.310</td>
<td>0.548</td>
</tr>
<tr>
<td>Reaching</td>
<td>0.297</td>
<td>0.227</td>
<td>0.205</td>
<td>0.275</td>
<td>0.082</td>
<td>0.082</td>
<td>0.082</td>
</tr>
<tr>
<td>AD &amp; Tics &amp; Gait</td>
<td>0.575</td>
<td>0.056</td>
<td>0.094</td>
<td>0.278</td>
<td>0.440</td>
<td>0.440</td>
<td>0.440</td>
</tr>
<tr>
<td>Limb apraxia/paresthesia</td>
<td>0.412</td>
<td>0.210</td>
<td>0.342</td>
<td>0.384</td>
<td>0.275</td>
<td>0.275</td>
<td>0.275</td>
</tr>
<tr>
<td>Babinski reflex</td>
<td>0.370</td>
<td>0.267</td>
<td>0.223</td>
<td>0.278</td>
<td>0.440</td>
<td>0.440</td>
<td>0.440</td>
</tr>
<tr>
<td>Sensorimotor apraxia</td>
<td>0.440</td>
<td>0.205</td>
<td>0.304</td>
<td>0.275</td>
<td>0.082</td>
<td>0.082</td>
<td>0.082</td>
</tr>
<tr>
<td>Nystagmus</td>
<td>0.358</td>
<td>0.365</td>
<td>0.342</td>
<td>0.278</td>
<td>0.342</td>
<td>0.342</td>
<td>0.679</td>
</tr>
<tr>
<td>Signs</td>
<td>0.403</td>
<td>0.319</td>
<td>0.721</td>
<td>1.549</td>
<td>1.975</td>
<td>1.975</td>
<td>1.975</td>
</tr>
</tbody>
</table>

Figure 2. Results from the exploratory factor analysis (n=364). A principal axis factor analysis on 20 items with an oblique rotation identified five factors (KMO = 0.87, Bartlett’s χ² p < 0.05). Interpretation of the five factors: Factor 1 = complex movements; Factor 2 = motor functions of the amyotrophic domain; Factor 3 = motor symptoms related to progressive supranuclear palsy; Factor 4 = motor functions of the extrapyramidal & cerebellar domain; Factor 5 = motor functions related to apraxia.

5. Comparison of motor performance

We compared performance on EMAS between patients diagnosed with mild cognitive impairment (MCI), Alzheimer’s disease (AD) and the three variants of frontotemporal dementia (FTD): Motor FTD patients have a significantly higher mean score compared to all other diagnostic groups (Kruskal Wallis χ²(4)=23.03, p<0.001). **significant at p < 0.01, all error bars are SEM.

6. Conclusions

1. There is much need for EMAS in clinic practice
2. EMAS appears to be a reliable tool with a valid multidimensional format
3. Motor impairments occur in patients with Alzheimer’s disease and frontotemporal dementias, but they do not appear to be diagnosis-specific

References