Chapter 7

Inter-individual variability of neurocognitive performances after electroconvulsive therapy in depressed patients: improvement and decline

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Submitted
Abstract

Background: Most of our knowledge about cognitive functioning after ECT is based on results analysed at group level. These mean group scores overlook inter-individual variability in neurocognitive performances which may limit clinical interpretation. This study investigated the presence of inter-individual variability in neurocognitive performances after ECT.

Methods: We studied inter-individual variability in neurocognitive performances after ECT in two different cohorts, representative for ECT practice. Neuropsychological tests were administered before ECT and one week after the last ECT session. Subgroups of patients with clinically relevant cognitive decline after ECT were compared with those with clinically relevant cognitive improvement. We examined whether specific demographic and clinical features discriminated between these two subgroups.

Results: Using several cognitive tests, the percentage of patients with clinically relevant cognitive decline ranged from 3% – 13% depending on the test. Clinically relevant improvement ranged from 0% - 12%.

26% of the patients showed clinically relevant improved cognition and 29% had decline with respect to their cognition on one or more tests. The subgroup with clinically relevant cognitive decline received a significantly higher number of index ECT sessions.

Conclusion: Neurocognitive side-effects after ECT showed considerable inter-individual variability. Decline of autobiographical memory and fluency tests were associated with more treatment sessions.
Introduction

The most frequently debated adverse effects of electroconvulsive therapy (ECT) are neurocognitive side effects such as decreased orientation immediately after ECT sessions, anterograde amnesia for recent information, and retrograde amnesia for long-term autobiographical and impersonal information. Other neurocognitive domains that can be impaired are processing speed, attention, verbal fluency and executive functioning (Fraser et al., 2008; Ingram et al., 2008; Semkovska and McLoughlin, 2010; Tielkes et al., 2008; Verwijk et al., 2012). Many authors suggest that neurocognitive adverse effects are transient, recovering to pre-ECT levels shortly after the ECT course is stopped. One meta-analysis found that some cognitive functions even improved beyond baseline levels (Semkovska and McLoughlin, 2010). However, reviews show retrograde autobiographical amnesia is still present between one and six months after unilateral brief pulse ECT (Fraser et al., 2008; Verwijk et al., 2012). Other studies do not show any neurocognitive decline post-ECT relative to pre-ECT functioning (Dybedal et al., 2014; Mayur et al., 2013; Sienaert et al., 2010; Verwijk et al., 2014). Depending upon techniques used in the administration of ECT, the degree of neurocognitive side effects varies (Fraser et al., 2008). Bitemporal ECT is reported to result in more pronounced cognitive adverse side effects than right unilateral (RUL) ECT (Prudic, 2008; Sackeim et al., 1993; Semkovska et al., 2011). Pulse width has also been reported to influence cognitive functioning, however conflicting results are found whether or not ultrabrief pulse ECT (<0.5 ms) induces less disturbances compared to brief pulse ECT (0.5-2.0 ms) (Loo et al., 2008; Sienaert et al., 2009; Spaans et al., 2013a).

Most of our knowledge about cognitive functioning after ECT is based on results analysed at group level. Nevertheless, there may be a variation and interplay in both individual vulnerability and treatment parameters explaining why cognition declines after ECT in some patients and improves in others (McClintock et al., 2014; Sackeim et al., 2007). Mean group scores can overlook this inter-individual variability. Group differences resulting from small changes in the majority of a sample should be differentiated from those caused by relatively large changes in the subset of a sample. Recently, Dybedal et al. (Dybedal et al., 2014) were the first to focus on both changes at the group level (differences in group means) and the individual case level (differences in percentages of cases with decline) in an elderly depressed group of patients (≥ 60 years) treated with ECT, making use of a comprehensive test battery. Cognitive side effects in the domains of memory, executive functions and information-processing
speed were examined within a week after ECT. Stable or improved performances were found most frequently at group level. At an individual level however, 11% of patients showed retrograde amnesia for public facts post-ECT and 40% of the patients showed a significant decline in neuropsychological functioning on two or more tests. A decline of delayed verbal anterograde memory most often occurred in 27% of the cases. Hausner et al. (Hausner et al., 2011) also identified global cognitive deficits to be transient at group level measured with the MMSE, but 46% of the elderly subjects (≥ 65 years) showed a decline after the sixth ECT. Despite the achieved remission 15% still showed declined MMSE performances six weeks post ECT. Their findings indicate that in spite of stable or improved neurocognitive performances at a group level, there may be neurocognitive impairments for a substantial minority of elderly depressed patients receiving ECT.

The first aim of this study was to detect inter-individual variability in neurocognitive performances -using several cognitive tests- after ECT in two different cohorts representative for ECT practice. Secondly, we compared the subgroup of patients that showed clinically relevant decline after ECT with those who showed clinically relevant improvement. We explored whether there were specific demographic and clinical features that discriminate between these two subgroups.

Methods

Neurocognitive data was available from two studies: a naturalistic ECT study and a randomized controlled trial (RCT).

Naturalistic study
This prospective naturalistic ECT study (Verwijk et al., 2014) evaluated the nature and extent of changes across multiple domains of neurocognitive functioning in a group (n=42) of elderly participants (mean age 72.7; range 58-91) one week and six months after ECT. Inpatients suffering from a primary major depressive disorder or bipolar depression (with or without psychosis) diagnosed according to DSM-IV criteria were included. The severity of depression was assessed weekly during the treatment period, one week after the end of the course by using the Montgomery Åsberg Depression Rating Scale (MADRS) (Montgomery and Åsberg, 1979). Sustained remission was defined as a MADRS score <10 at two consecutive measurements.
RCT
The double blind RCT compared the efficacy and cognitive side effects (autobiographical memory and executive functioning) of brief pulse (BP) with ultrabrief pulse (UBP) right unilateral stimuli over a period of 6 weeks. Then followed by a naturalistic, open follow up period of six months in a group of 116 participants (mean age 60.6; range 26-90) (Spaans et al., 2013b). Inpatients suffering from a primary major depressive disorder or bipolar depression (with or without psychosis) diagnosed according to DSM-IV criteria were included. The severity of depression was assessed on a weekly basis during the treatment period, one week after the end of the course by using the (MADRS) with sustained remission defined as a MADRS score <10 at two consecutive measurements.

ECT procedures
In both studies patients received a course of twice weekly ECT. Both Etomidate, (0.2-0.3 mg/kg) and succinylcholine (1-2 mg/kg) were used for anaesthetic induction and muscle relaxation, respectively.

Naturalistic study
In the naturalistic study ECT was started preferably with right unilateral stimuli to minimise cognitive side-effects (NICE, 2003). All treatments were administered using a Thymatron system IV (Somatics, LLC, Lake Bluff, Illinois; USA; maximum energy 200%, 1008 mCoulombs) with a brief pulse (1.0 millisecond) stimulus. An age-dosing protocol was used for unilateral treatments, i.e. a 75-year-old patient would receive right unilateral ECT at a dosage of 75%, corresponding with 378 mCoulombs. When treated bilaterally (only bitemporal) half of this dosage was considered adequate (Petrides and Fink, 1996). Switching to bilateral ECT was done when the clinical condition worsened or after 6 unilateral treatments without effect, despite adequate motor seizures (≥20 seconds). ECT treatment was stopped if patients had remitted or showed no further improvement in clinical condition during the last two weeks of ECT sessions. Worsening was determined by debilitating psychotic features, increased suicidal thoughts, dehydration or weight loss. Psychotropics were tapered off prior to the start of ECT. Antipsychotics were allowed when clinically indicated.

RCT
In the RCT, patients were randomized to treatment with either BP (1.0 millisecond) or UBP (0.3 millisecond) RUL ECT (Spaans et al., 2013b) delivered by a constant current device (spECTrum 5000 Q MECTA inc., Tualatin, OR) with a maximum stimulus
level of 1152 mC using RUL d’Elia electrode placement (d’Elia, 1970). In accordance with daily clinical practice, antidepressants were continued during ECT including lithium at plasma levels of 0.40 – 0.80 mmol/L. Benzodiazepines were tapered to a maximum of 10 mg diazepam equivalents, three days prior to ECT. Psychotropic and somatic medications were kept stable until the end of the study. A titration procedure was followed during the first session to determine the seizure threshold. The first and successive treatment sessions were then continued with a stimulus eight times the seizure threshold. The ECT course was terminated when the patient reached remission. Either continuation-ECT or prophylactic drug treatment was started after finishing the ECT-course. A switch to bilateral ECT was made when the clinical condition worsened or after 12 unilateral treatments without sufficient effect, despite adequate seizures.

Neurocognitive assessments
In both studies, a neuropsychologist or a supervised trainee neuropsychologist performed neurocognitive assessment. Assessments were done a week before the first ECT (pre-ECT) and one week after finishing the treatment course (post-ECT). In the RCT assessments after the sixth ECT were done as well.

Naturalistic study
The cognitive domains studied in the naturalistic study included global cognitive status, episodic memory (verbal, anterograde), speed of information processing and executive function/working memory. The specific instruments in the test battery were: the Mini Mental State Examination (MMSE) (global cognitive function) (Folstein et al., 1975), the Visual Association Test (VAT) (automatic learning) (Lindeboom et al., 2002), a modified version of the auditory verbal learning test (Rey, 1964), 10 Words Verbal Learning Task, (verbal learning, retention), Digit Span forwards and backwards – Wechsler Adult Intelligence Scale III (WAIS III) (attention and working memory) (Wechsler, 2000), Expanded Mental Control Test (EMCT) (mental control) (Lindeboom et al., 1993), the Stroop Color Word Test (attention and executive functioning) (Strauss et al., 2006), the Trail Making Test (TMT) (attention, visual motor speed and executive function) (Reitan, 1979), and 2 subtests (Key Search & Rule Shift Cards) of the Behavioural Assessment of the Dysexecutive Syndrome (BADS) (executive function) (Wilson et al., 1997).
**RCT**

The cognitive domains studied in the RCT included retrograde amnesia for autobiographical memory (personal events), retrograde amnesia for biographical memory (impersonal events), as well as executive function. The specific instruments used in the RCT assessments were: Kopelman’s Autobiographical Memory Interview (AMI Kopelman), a validated test used to assess retrograde amnesia for autobiographical memory (personal events). This interview is a reliable and standardized test to assess personal remote memory (Kopelman et al., 1990). The Amsterdam Media Questionnaire (AMQ) (Meeter et al., 2006) was used to assess retrograde amnesia for biographical memory (impersonal events). Two different verbal fluency tests (Wordfluency—animals & professions and Letterfluency—“D,” “A,” “T”) (Luteijn and van der Ploeg, 1983) were used to monitor executive functioning.

**Statistical analysis**

All patients of both studies that completed a pre- and post ECT cognitive assessment were included for analysis. For analyzing change in individuals, we calculated the change in raw scores of pre- and post ECT for each individual on each cognitive assessment and transformed them into z-scores. Negative z-scores (< 0) indicate a decline and positive z-scores (>0) indicate an improvement. We defined z-scores ≤-1.5 or ≥1.5 as a clinically relevant decline or improvement, respectively. Next, with respect to their demographic and clinical characteristics, we compared the group of patients who showed a clinically relevant improvement in cognition, with those who showed a clinically relevant decline in cognition. We used two-tailed t tests or Mann-Whitney U tests and Pearson’s chi-square tests or Fisher’s Exact tests where appropriate. Results were considered statistically significant at a p value lower than 0.05. We used IBM SPSS Statistics for Windows, version 20 for all statistical analyses (IBM, 2012).

**Results**

**Post-ECT individual neurocognitive variability**

The demographic and clinical patient characteristics of both the RCT and the naturalistic samples are presented in Table 1. Neurocognitive data of both samples was evaluated for individual neurocognitive performance variability (decline or no change/improvement post-ECT). Figure 1 presents the percentages of participants that declined or improved on each cognitive test as well as participants whose decline or
improvement was clinically relevant post-ECT. The results show that in each cognitive test subgroups of participants declined or improved post ECT, whereas analyses at group level showed no change or even showed significant improvement in some cognitive tests-scores (e.g. MMSE, VAT learning and retention, 10 WLVT learning, AMQ and EMCT) [published elsewhere (Verwijk et al., 2014)].

Table 1 Demographic and clinical characteristics RCT and naturalistic study

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>RCT (n=76)</th>
<th>Naturalistic study (n=42)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (sd; range)</td>
<td>60.6 (15.5; 26-90)</td>
<td>72.7 (7.9; 58-91)</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>51 (67.1)</td>
<td>28 (66.7)</td>
</tr>
<tr>
<td>Education level, median (interquartile range)</td>
<td>4 (2)</td>
<td>4 (2)</td>
</tr>
<tr>
<td>Current episode duration (months), mean (sd; range)</td>
<td>23.9 (48.1; 1-324)</td>
<td>11.8 (14.1; 2-80)</td>
</tr>
<tr>
<td>Unipolar, n (%)</td>
<td>64 (84.2)</td>
<td>39 (92.9)</td>
</tr>
<tr>
<td>Psychotic, n (%)</td>
<td>28 (36.8)</td>
<td>17 (40.5)</td>
</tr>
<tr>
<td>Early onset depression (&lt;55), n (%)</td>
<td>54 (71.1)</td>
<td>14 (33.3)</td>
</tr>
<tr>
<td>MADRS mean (sd; range)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>30.0 (9.0; 5-51)</td>
<td>33.5 (10.8; 11-51)</td>
</tr>
<tr>
<td>End</td>
<td>11.2 (10.8; 0-39)</td>
<td>9.4 (8.3; 0-31)</td>
</tr>
<tr>
<td>History of ECT, n (%)</td>
<td>22 (28.9)</td>
<td>Not available</td>
</tr>
<tr>
<td>Brief pulse, n (%)</td>
<td>34 (44.7)</td>
<td>42 (100)¹</td>
</tr>
<tr>
<td>Number of index ECT treatments, mean (sd; range)</td>
<td>9.6 (2.8; 4-12)</td>
<td>11.9 (4.1; 6-26)</td>
</tr>
</tbody>
</table>

¹ 71.4% unilateral only; 26.2% unilateral and bilateral
MADRS = Montgomery Åsberg Depression Rating Scale

**Clinically relevant cognitive decline**

The percentage of patients with clinically relevant cognitive decline, with respect to anterograde verbal-learning, ranged from 3% to 13%. For the other neurocognitive domains the ranges of clinically relevant decline were as follow: anterograde retention 3% to 7%; retrograde memory 6% to 8%; working memory 7% to 12%; processing speed 4% to 11%; executive function 4% to 9%.
Inter-individual variability of neurocognitive performances after ECT

**Figure 1** Percentage participants with cognitive improvement and decline post-ECT

<table>
<thead>
<tr>
<th>Cognitive Test</th>
<th>Clinically Relevant Improvement</th>
<th>Clinically Relevant Decline</th>
<th>No Change or Improvement</th>
<th>Significant Change at Group Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMI Kopelman</td>
<td>9%</td>
<td>0%</td>
<td>0%</td>
<td>ns</td>
</tr>
<tr>
<td>AMQ</td>
<td>10%</td>
<td>0%</td>
<td>0%</td>
<td>ns</td>
</tr>
<tr>
<td>Category Fluency</td>
<td>9%</td>
<td>0%</td>
<td>0%</td>
<td>ns</td>
</tr>
<tr>
<td>Letter Fluency</td>
<td>5% to 6%</td>
<td>0%</td>
<td>0%</td>
<td>ns</td>
</tr>
<tr>
<td>Stroop Card 1</td>
<td>4% to 12%</td>
<td>0%</td>
<td>0%</td>
<td>ns</td>
</tr>
<tr>
<td>Stroop Card 2</td>
<td>4% to 12%</td>
<td>0%</td>
<td>0%</td>
<td>ns</td>
</tr>
<tr>
<td>Trail Making A</td>
<td>0% to 4%</td>
<td>0%</td>
<td>0%</td>
<td>ns</td>
</tr>
<tr>
<td>Trail Making B</td>
<td>4% to 12%</td>
<td>0%</td>
<td>0%</td>
<td>ns</td>
</tr>
</tbody>
</table>

**Clinically relevant cognitive improvement**

The percentage of patients with clinically relevant cognitive improvement, with respect to anterograde verbal-learning, ranged from 9% to 10%. For the other neurocognitive domains the ranges of clinically relevant improvement were as follow: anterograde retention 9% to 10%; retrograde memory 5% to 6%; working memory 9% to 10%; processing speed 0% to 4%; executive function 4% to 12%.

Figure 2 illustrates that in the RCT clinically relevant improvement or decline was already present before the 7th ECT session on the AMI Kopelman, AMQ and Category fluency.
Demographic and clinical differences between clinically relevant cognitive improved and declined patients

**Naturalistic study**

The subgroups that clinically relevant improved and declined after ECT on one or more tests in the naturalistic study, were too small (n=8 (19%) and n=7 (17%), respectively) for further analysis.

**RCT**

In the RCT sample, 20 (26%) patients out of 76 were identified as showing clinically relevant cognitive improvement and 22 (29%) patients as having clinically relevant cognitive decline after ECT on one or more tests. We compared the demographical, clinical and neurocognitive differences of these two subgroups (Table 2). The subgroup that cognitively declined had a significantly higher number of index ECT treatments (Table 2 and Figure 3). Cognitive performance pre-ECT showed no statistically significant differences between the subgroups, except for the performance on the AMI Kopelman (autobiographical memory). The subgroup of patients that declined after ECT had a higher score on this test before ECT started.
Table 2 Demographic and clinical characteristics RCT (n=76) post-ECT clinically relevant improvement and clinically relevant decline

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>post-ECT clinically relevant improved (n=20)</th>
<th>post-ECT clinically relevant declined (n=22)</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (sd; range)</td>
<td>65.0 (16.5; 28-90)</td>
<td>55.1 (16.5; 26-81)</td>
<td>0.059</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>14 (70.0)</td>
<td>16 (72.7)</td>
<td>1.000</td>
</tr>
<tr>
<td>Education level, median (interquartile range)</td>
<td>4 (3)</td>
<td>5 (2)</td>
<td>0.241</td>
</tr>
<tr>
<td>Current episode (months), mean (sd; range)</td>
<td>10.2 (14.3; 1-60)</td>
<td>42.0 (82.7; 1-324)</td>
<td>0.097</td>
</tr>
<tr>
<td>Unipolar, n (%)</td>
<td>17 (77.3)</td>
<td>17 (85.0)</td>
<td>0.700</td>
</tr>
<tr>
<td>Psychotic, n (%)</td>
<td>7 (35.0)</td>
<td>8 (36.4)</td>
<td>1.000</td>
</tr>
<tr>
<td>Early onset depression (&lt;55), n (%)</td>
<td>15 (75.0)</td>
<td>16 (72.7)</td>
<td>1.000</td>
</tr>
<tr>
<td>MADRS mean (sd; range)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>32.4 (7.5; 21-47)</td>
<td>28.3 (11.3; 5-46)</td>
<td>0.174</td>
</tr>
<tr>
<td>End</td>
<td>9.6 (11.2; 0-36)</td>
<td>13.8 (12.2; 0-39)</td>
<td>0.252</td>
</tr>
<tr>
<td>History of ECT, n (%)</td>
<td>6 (30.0)</td>
<td>8 (36.4)</td>
<td>0.750</td>
</tr>
<tr>
<td>Brief pulse, n (%)</td>
<td>9 (45.0)</td>
<td>10 (45.5)</td>
<td>1.000</td>
</tr>
<tr>
<td>Number of index ECT treatments, mean (sd; range)</td>
<td>8.3 (2.9; 4-12)</td>
<td>10.5 (2.4; 5-12)</td>
<td>0.012</td>
</tr>
<tr>
<td>Remission after index ECT (MADRS &lt; 10), n (%)</td>
<td>14 (70.0)</td>
<td>10 (45.5)</td>
<td>0.131</td>
</tr>
<tr>
<td>Baseline:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMI Kopelman, mean (sd; range)</td>
<td>52.4 (17.3; 21-58)</td>
<td>66.5 (15.0; 25-89)</td>
<td>0.007</td>
</tr>
<tr>
<td>AMQ, mean (sd; range)</td>
<td>20.3 (10.1; 1-37)</td>
<td>20.3 (10.3; 3-41)</td>
<td>0.994</td>
</tr>
<tr>
<td>Category fluency, mean (sd; range)</td>
<td>22.2 (12.0; 5-49)</td>
<td>27.1 (10.0; 6-49)</td>
<td>0.163</td>
</tr>
<tr>
<td>Letter fluency, mean (sd; range)</td>
<td>23.2 (15.0; 5-60)</td>
<td>31.1 (14.7; 2-65)</td>
<td>0.128</td>
</tr>
</tbody>
</table>

MADRS = Montgomery Åsberg Depression Rating Scale; AMI = Autobiographical Memory Interview Kopelman; AMQ = Amsterdam Media Questionnaire

* Two-tailed t test, Chi-square or Mann-Whitney U test, where appropriate
Discussion

Our results showed that subgroups of patients whose cognitive function clinically relevant declined or improved could be detected. In our study, the size of the subgroup that declined or improved varied respectively from 3% to 13% and 0% to 12% along the different neuropsychological tests. Deficits were evident for memory function as well as for attention and executive function. No detection of clinically relevant decline or improvement was seen on the MMSE, an instrument for global cognitive functioning frequently used in ECT research. This implies that caution is needed when the MMSE is used for individual evaluation of cognitive decline or improvement because this instrument is not sensitive enough to detect clinically relevant differences.

The percentage of patients that clinically relevant declined or improved on one or more tests was 29% and 26% respectively. Our percentage for decline seems to contradict the 40% of cognitive decline in the findings of (Dybedal et al., 2014). In their study patients were given ECT twice weekly also, but approximately half of the patients were treated with bifrontal ECT, which could have had more impact on the cognitive outcome.
Determinants of differences between the clinically relevant declined and improved subgroups

As far as we know, this is the first study examining whether the demographic and neuropsychological characteristics, neuropsychiatric symptoms and technical ECT parameters differed between the two subgroups. The subgroup that clinically relevant declined received a significantly higher number of ECT’s. The association between a higher number of ECT treatments and declined cognitive performance is in line with earlier studies (Sackeim et al., 2007; Sienaert et al., 2010). Furthermore, we found a trend showing the improved subgroup was 10 years older, had a 32 month shorter duration of the current episode and had a worse cognitive performance at baseline. Older age or worse cognitive performance pre-ECT is not expected to be related to improved neurocognitive performance post ECT (Hausner et al., 2011; Sackeim et al., 2008; Semkovska and McLoughlin, 2010; Sobin et al., 1995). We argue that this group might represent the melancholic, psychomotor retarded subtype of depression. This subtype of depression is more often seen in elderly depressed patients and is often associated with worse pre-existing neurocognitive inefficiencies or impairments (Korten et al., 2014; Paradiso et al., 2010). As depression is a heterogeneous disorder comprised of a variety of depressive symptoms, the neurocognitive profile may vary person to person (Korten et al., 2014), and therefore could moderate neuropsychological associated effects of ECT.

Strengths and limitations

Global cognitive function and memory function such as anterograde memory and retrograde memory, as well as non-memory cognitive functions, including attention and executive functions were assessed and evaluated. Some important limitations have to be addressed. The clinically relevant cognitive improved and declined subgroups in the naturalistic study were too small for further demographical and clinical subgroup analysis. The conclusion that the clinically relevant cognitive declined subgroup received a significantly higher number of ECT’s only counts for the tests used in the RCT and can not be generalised to the cognitive tests used in the naturalistic study. Although our results indicated that a subgroup of patients showed cognitive decline after ECT, we do not know whether or not these effects improved in the first weeks after ECT. At group level there is an expectation of considerable improvement long term after ECT (Semkovska and McLoughlin, 2010; Verwijk et al., 2012), but follow up analysis is needed to confirm whether this is true for the cognitively impaired subgroup. Follow up analysis of our impaired subgroup was not possible because of the high drop out
rate of 82% (18/22) due to continuation of ECT (22%), relapse (33%) or loss to follow up because they had to travel too long and/or were unable to complete the tests (44%). The small numbers of our subgroups are also a limitation implying a low power, which could be an explanation for not reaching statistical significance of some differences. Finally, determinants of differences between declined and improved subgroups like ECT related neurophysiological changes and biomarkers were not available to be able to make a comparison. In a recent study (van Waarde et al., 2014) a functional MRI marker was found to predict the efficacy of ECT which is a promising finding. It would be interesting to replicate this study to explore if such a marker could also be found for predicting cognitive adverse effects.

Conclusion

Neurocognitive side effects after ECT showed inter-individual variability, where 29% of the patients clinically relevant declined and 26% clinically relevant improved on one or more tests. Decline on the autobiographical memory and fluency tests were associated with a higher number of treatment sessions. The MMSE should preferably not be used for individual evaluation of cognitive decline or improvement because this instrument is not sensitive enough to detect clinically relevant differences.
References


Chapter 7


