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Replication analysis for composition of the Delirium Motor Subtype Scale (DMSS) in a referral cohort from Northern India

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ABSTRACT

The Delirium Motor Subtype Scale (DMSS) was developed by discerning the best differentiating motor activity symptoms from the Delirium Motor Checklist (DMC), a compilation of psychomotor symptoms from other subjective scales. To broaden its validation we replicated the original work done in a palliative care population in a psychiatric referral population. 100 consecutive C/L Psychiatry referrals with DSM-IV delirium in an Indian general hospital were assessed with the Delirium Rating Scale-Revised-98 (DRS-R98) and DMC and compared to 60 nondelirious hospitalized controls. Disturbances of motor activity were almost invariably present in patients with delirium and at a much higher frequency than in nondelirious control subjects. Principal components analysis identified 5-factors for the DMC where Factor 1 explained 37.3% of the variance and correlated significantly with DRS-R98 motor items. Items loading at >0.65 were selected for the replication scale if they also either correlated significantly with DRS-R98 motor items or were significantly more frequent in delirious patients vs. controls. The resultant scale comprised 12 items (five hyperactive and seven hypoactive) and was similar to the original DMSS. Combining motor items from the original DMSS and replicated version produced a 13-item amended DMSS that may have broader generalizability than the original DMSS.

1. Introduction

Delirium is a complex neuropsychiatric syndrome characterized by inattention, generalized cognitive impairment, disturbed higher order thinking, and a range of noncognitive disturbances that include altered sleep–wake cycle and motor behavior. Different motor presentations have been described since the time of the ancient Greeks who recognized that physically morbid patients often experience cognitive disturbance associated with varying patterns of altered motor activity as 'lethargus' (reduced) and 'phrenitis' (increased) respectively. Lipowski (1983) suggested that these overt presentation differences reflected possible motor subtypes of the same delirium syndrome, where cognitive and other symptoms were relatively constant. Lipowski (1983) suggested 'hyperactive' and 'hypoactive' as labels for delirium subtypes, characterized by increased and decreased motor activity respectively before adding a third 'mixed' category in recognition that many patients experience elements of both within short time frames.

Interest in delirium motor subtypes over the decades has resulted in several subjective psychomotor symptom checklists that include a wide range of motor and nonmotor features (Lipowski, 1989; Liptzin and Levkoff, 1992; O'Keeffe and Lavan 1999), though none have been validated using nondelirious controls or independent measurements of motor behavior. Some require only one symptom to define a subtype which could be nonmotor. The highly disparate literature reporting the frequency of motor subtypes and their clinical associations and implications in delirium may in part reflect inherent inadequacies of such nonvalidated subtyping methods. While a simple, valid bedside subtyping tool could provide benefit to the field, there is a void in current clinical practice and most extant research. To disentangle the meaning of motor presentations in delirium and whether subtypes might indicate meaningful differences in underlying neuropathophysiology, treatment

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methods or outcomes requires a better and validated methodology (Meagher, 2009). To this end, when comparing three psychomotor checklists with each other and the Delirium Rating Scale-Revised-98 (DRS-R98) motor items to define subtypes in the same study population, Meagher et al. (2008a) found only 34% motor subtype concordance, highlighting great inconsistency across historical subtyping approaches.

To develop a valid tool to subtype motor presentations of delirium, all 30 features previously described in psychomotor checklists were combined to form a complete list, called the Delirium Motor Checklist (DMC) which was then evaluated in a population of delirious patients and nondelirious controls (Meagher et al., 2008b). Analysis identified 11/30 DMC items that significantly distinguished between groups and also correlated with independently measured DRS-R98 motor items, which resulted in a new scale called the Delirium Motor Subtype Scale (DMSS) (Meagher et al., 2008b). The DMSS is a simple scale designed for use by both physicians and other clinical staff that focuses on motor, not psychomotor, features of delirium. It also has demonstrated concurrent and predictive validity including comparison to objectively measured motor activity levels using an accelerometry method (Leonard et al., 2007; Godfrey et al., 2010). The DMSS has been used in the only existing longitudinal study of motor subtype profile in delirium (Meagher et al., 2011, 2012). No other rating scale for motor subtypes of delirium has been developed and validated with such rigor. However, validation studies for the DMSS have largely focused on palliative care populations where motor activity profile can be impacted by a variety of factors, including high rates of polypharmacy and the extreme physical frailty of patients nearing death. As such, further work is needed to explore the attributes of this scale when applied to other populations with delirium.

The aims of this study were to replicate and extend the validation analyses for the original development of the DMSS in referrals to an adult consultation–liaison psychiatry service in India with and without DSM-IV diagnosed delirium. Analysis for DMC items to produce a replication DMSS included determination of the factor structure, frequency comparison between delirious and nondelirious cases, and correlation with independently measured hypoactivity and hyperactivity. The subtype attribution using the replicated DMSS was compared to that using the original DMSS.

2. Methods

2.1. Subjects and design

This prospective cross-sectional study was carried out at the Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, a multi-specialty tertiary-care teaching hospital that provides services to a population of approximately 40 million in Northern India and that includes Union Territory of Chandigarh and the states of Punjab, Haryana, Himachal Pradesh, Jammu and Kashmir, and Rajasthan. The Department of Psychiatry provides a 24 h consultation–liaison psychiatry service to all the wards and the emergency service of the hospital.

Patients referred from medical–surgical and emergency wards to the Consultation–Liaison (C/L) Psychiatry services who had DSM-IV delirium (American Psychiatric Association, 1994) were prospectively evaluated. Cases were included if they met DSM-IV criteria for delirium (as per the consulting psychiatrist's assessment) and also scored above diagnostic cutoff scores for delirium as per the DRS-R98. In order to minimize the influence upon motor activity profile due to other neuropsychiatric conditions, subjects with a documented history of dementia or other Axis I psychiatric disorder (except substance use disorders) were excluded. In addition, 60 patients referred to the C/L Psychiatry service but without DSM-IV delirium were also included as controls to allow for a comparison of motor activity profile.

Assessments were conducted by raters trained in the use of the Delirium Rating Scale-Revised-98 (DRS-R98) (Trzepacz et al., 2001), DMSS and Delirium Motor Checklist (DMC) (Meagher et al., 2008a). Sociodemographic and clinical profiles were recorded on a structured proforma. All assessments were based on all available information obtained from the patients, caregivers, medical staff and medical records. According to local practice, pharmacotherapy is usually initiated after psychiatric assessment and as such this cohort had received minimal prior exposure to psychotropic agents used to treat delirium.

2.2. Procedures

The *Delirium Motor Checklist* (DMC) (Meagher et al., 2008a) is comprised of features from three published psychomotor subtyping schemas (Lipowski, 1983; Liptzin and Levkoff, 1992; O'Keeffe and Lavan, 1999) that were combined to form a new 30-item checklist but without redundant items. While some items directly reflect alterations in motor activity (e.g. increased amount or speed of actions), other 'psychomotor' items are indirectly related to motor activity (e.g. uncooperativeness, altered speed or volume of speech). Each item was rated as present (1) or absent (0) during the previous 24 h through observation and discussion with the key nurse responsible for the patient at the time of assessment.

The *Delirium Motor Subtype Scale* (DMSS) (Meagher et al., 2008b) is a scale comprising 11 pure motor symptoms (four hyperactive and seven hypoactive features) derived from the 30-items of the DMC that were selected according to their relative specificity for delirium relative to controls, reflection of motor phenomenology, and demonstrated correlation with independent and objective measures of motor behavior (Meagher et al., 2008b; Godfrey et al., 2010). DMSS items appear in bold text in Table 1. The DMSS can be rated by any healthcare professional that is familiar with delirious patients' behavior and can be used to rate periods of time of 24 h or more where each item is rated dichotomously as present or absent. Scoring requires at least two symptoms to be present from either the hyperactive or hypoactive list to meet subtype criteria. Patients meeting both hyperactive and hypoactive criteria are deemed mixed subtype, while patients meeting neither criteria are labeled 'no' subtype. The DMC and DMSS were rated for the preceding 24 h period.

The *Delirium Rating Scale-Revised-98* (DRS-R98) (Trzepacz et al., 2001) is a 16-item scale with 13 severity and three diagnostic items with high reliability, validity, sensitivity and specificity for diagnosing and measuring the severity of delirium in mixed neuropsychiatric and other hospital populations. Each item is rated 0 (absent/normal) to 3 (severe impairment) with phenomenological descriptions anchoring each severity level. Item ♯7 rates motor agitation, while item #8 rates motor retardation. DRS-R8 Severity scale scores range from 0 to 39 with higher scores indicating more severe delirium. Delirium typically involves scores above 15 points (Severity scale) or 18 points (Total scale) even when dementia is in the differential diagnosis. The DRS-R98 was rated by the psychiatrist for the preceding 24 h period.

2.3. Informed consent

The procedures and rationale for the study were explained to all patients but because many patients had cognitive impairment at entry into the study, it was presumed that most were not capable of giving informed written consent. Because of the non-invasive nature of the study, ethics committee approval was given to augment patient assent with proxy consent from next of kin (where possible) or a responsible caregiver in accordance with the Helsinki Guidelines for Medical Research involving human subjects (World Medical Association, 2004).

2.4. Statistical analysis

Statistical analyses were conducted using SPSS Version 16.0. Continuous variables for demographic and DRS-R98 data are expressed as means and standard deviations. Comparison of the frequency of DMC items between delirious and nondelirious patients was done using the Fishers Exact test, and then the significance of the relationship between presence of DMC items and presence on the DRS-R98 items for motor activity (at any severity level) was calculated using the chi-square test. Items from the DMC in delirious patients were entered into a principal components analysis (PCA) using orthogonal rotation, and Varimax technique, so as to identify the minimum number of factors explaining the maximum variance in the data. In addition, criteria for factors of an Eigenvalue >1.5 and accounting for at least 5% of the variance of the solution were applied (Schonrock-Adema et al., 2009; Hatcher, 1994). Pearson product moment correlation values were used to explore the correlation between these factors and independent ratings of motor agitation (DRS-R98 item ♯7) and motor retardation (DRS-R98 item ♯8).

DMC items to be selected to comprise the replication DMSS needed to load at >0.65 onto a PCA factor and also needed to meet at least one of the following criteria: associate significantly ($p<0.001$ by chi-squared testing) with DRS-R98 motor item ♯7 or ♯8 as appropriate by its motor descriptor (i.e., hyperactive or hypoactive) *or* be significantly ($p<0.001$) more frequent in delirious as compared to nondelirious controls.

Comparisons were made between the replication and original DMSS versions for their constituent items. An amended DMSS comprised items from both versions and also excluded two cognitive items from the replicated DMSS. The frequency of motor subtypes identified when the replicated and original DMSS versions were applied to delirium cases was compared using a chi-squared test.