Original article

Comparison of MMSE to DSM-IV diagnostic criteria for the detection of delirium in medically ill patients with psychiatric referrals

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Abstract

***Background**: Despite wide-spread use of Mini Mental State Examination (MMSE) to screen for cognitive impairment, it has been inadequately studied in Indian samples and there is a need to compare it to standard diagnostic criteria. **Aim**: The current study aimed to (a) assess the optimal cut-off for MMSE to detect delirium, using DSM-IV TR as gold standard (b) assess the relation of MMSE scores to the risk of getting diagnosed with delirium. **Method**: It was a hospital based, cross-sectional study of 149 consecutive patients referred for behavioral abnormalities from various other departments over a year. MMSE was administered in each case and a clinical diagnosis of delirium was established using DSM IV-TR by a psychiatrist blind to MMSE score. **Results**: Using Receiver Operator Curve analysis, the optimal cut-off score of MMSE was found to be 24.5 (Sensitivity=0.97 & Specificity=0.69). The Area under Curve was 0.837. The MMSE score, by the logistic model, correctly predicted a diagnosis of delirium in 77.9% cases. For each unit increase in MMSE score, the odds of receiving a diagnosis of delirium were reduced by 76.9%. **Conclusion**: MMSE is a useful tool for detection of delirium in Indian patients at an optimum cut-off score of 24.5. Even mild changes in cognitive functioning evident on MMSE are predictive of a diagnosis of delirium.*

***Keywords**: Delirium, MMSE, Cut-off score, Cognitive decline, India*

Introduction

According to Diagnostic and Statistical Manual 4th edition, Text Revision (DSM-IV TR),[1] the diagnosis of delirium requires a disturbance of consciousness, with a reduced ability to focus, sustain or shift attention; and changes in cognition or the development of a perceptual disturbance. These disturbances develop over a short period of time, with a fluctuating course and are caused due to physiological consequences of a general medical condition. Several instruments and methods [2] are available for the detection, diagnosis and rating of delirium. These can be (a) Screening tests to measure cognitive impairment to screen for delirium e.g. Mini Mental State Examination (MMSE)[3]; (b) Delirium diagnostic instruments based on DSM/ICD criteria e.g. Confusion Assessment Method[4]; (c) Delirium-specific numerical rating scales, whose scores can be used to know the likelihood of diagnosis or estimating severity e.g. Delirium Rating Scale,[5] and (d) Laboratory-based tests for physiological correlates of delirium.

MMSE is one of the most frequently used neuropsychological tests for screening of delirium. Internal consistency of the MMSE has been found to be good to excellent, with alpha coefficients ranging from 0.54 to 0.96 depending on the study.[2] Folstein and colleagues[3] did not report the cut-off value for delirium separate from that of dementia. Subsequently, various studies[2,6-9] have reported that a cut-off score of 24 indicates the presence of cognitive impairment. MMSE is a widely used screening tool, however its important caveat is that the degree of importance to be attached to presence of cognitive impairment as a symptom for diagnosis of delirium remains unclear.

There is a need to compare MMSE to that of clinical diagnosis by DSM-IV TR diagnostic criteria. Earlier studies had compared MMSE against diagnostic scales for delirium and did not find it to be useful for a diagnosis of delirium.[10-13] One of the studies[14] comparing MMSE to Memorial Delirium Assessment Scale (MDAS) and Delirium Rating Scale (DRS) suggested a relationship between severity of delirium and MMSE scores. Another study included MMSE cut off of 24 or less in order to establish the presence of cognitive disturbance, which is one of the DSM- IV diagnostic criteria for delirium.[15]

The present study had following aims:

(a) To assess the optimum cut off score of MMSE against DSM-IV TR criteria (as gold-standard) to detect delirium in a sample of Indian patients.

(b) To assess the relationship of MMSE scores to the risk of getting diagnosed with delirium.

Materials and Method

This is a cross-sectional, hospital-based study carried out at the Department of Psychiatry at tertiary care centre, Shree Krishna hospital, Karamsad, Gujarat. It has been conducted as a part of a larger study on delirium by same group of researchers.[16] The sample comprised of patients who were aged 18 and above and were consecutive referrals to a psychiatrist for a behavioural abnormality by other clinical departments in the hospital over a period of one year. Terminally ill and grossly uncooperative patients were excluded as administering MMSE was difficult on this subset of patients.

The written informed consent was obtained from the patient or the close relative if patient was unable to do so, in the language easily understandable by them. The study was approved by the Institutional Ethics Committee.

Instruments

- Semi structured proforma: for the socio-demographic and clinical details
- Mini Mental State Examination (MMSE)[3] : It is a cognitive screening test comprising of 11 items, which include orientation to place and time, registration, attention and concentration, recall, language(object naming, repetition, comprehension, reading, writing and three step command) and visual construction (copying design). The maximum score is 30 points and requires 5-10 minutes to administer.
- DSM-IV TR[1] Diagnostic criteria for delirium: After the socio-demographic and clinical details, MMSE was administered to the patient population by one of researchers, following which the diagnosis was made according to DSM IV-TR[1] by another researcher based on all the available clinical information. Latter was blind to the MMSE score and no more than ten minutes elapsed between administration of MMSE and DSM IV- TR diagnosis for any of the patients.

Statistical Analysis

Statistical analysis was done by using SPSS version 14. The frequency distributions were calculated for demographic data. In order to find cut-off of MMSE score with respect to DSM-IV TR , ROC analysis was done. Logistic regression analysis was done for identifying the change in odds of getting a diagnosis of delirium with respect to MMSE scores.

Results

Out of 149 cases of suspected delirium referred from various specialties of the tertiary care hospital , 36 (24.2%) were identified to have delirium as per the DSM-IV-TR criteria. The mean age was 44.04 ±19.29 years and there were 87 (58.4%) males and 62 (41.6%) females in the entire sample. There were 134 (89.9%) married, 11 (7.4%) unmarried and 4 (2.7%) widowed subjects; 74 (49.7%) were from urban and 75 (50.3%) from rural areas. Out of 36 subjects with delirium, 17(47.2%) were males and 19 (52.7%) were females; 30 (83%) were married, 4 (11%) widowed and 2 (5.5%) unmarried; 17 (47.2%) were from urban and 19 (52.7%) from rural areas. There was no significant differences in socio-demographic variables between those with or without delirium.

Table 1 shows the comparison of MMSE score (<24) for cognitive decline against DSM-IV-TR, and the sensitivity was found to be 0.805. The sensitivity and specificity of MMSE scores were calculated using Receiver Operating Characteristic curve (ROC) analysis separately. Table 2 shows the optimal cutoff 24.5, for which the sensitivity was 0.97, specificity 0.69 and area under curve 0.837. Only one case was wrongly detected as negative at this cut off score of MMSE (false negative). At the cut-off 22.5 the specificity would increase to 0.76 but the sensitivity was decreased considerably (0.72).

Table 1: MMSE < 24 versus DSM IV-TR

	DSM-IV TR delirium		
	Present	**Absent**	**Total**
MMSE < 24	29	32	61
MMSE ≥ 24	7	81	88
Total	36	113	149

Table2: ROC analysis: sensitivity and specificity of MMSE

MMSE score	Sensitivity	Specificity
14.5	0.19	0.99
15.5	0.22	0.97
16.5	0.31	0.96
17.5	0.31	0.93
18.5	0.44	0.92
19.5	0.47	0.88
20.5	0.50	0.83
21.5	0.61	0.80
22.5	0.72	0.76
23.5	0.81	0.72
24.5	**0.97**	**0.69**
25.5	0.97	0.58
26.5	0.97	0.38
27.5	0.97	0.28

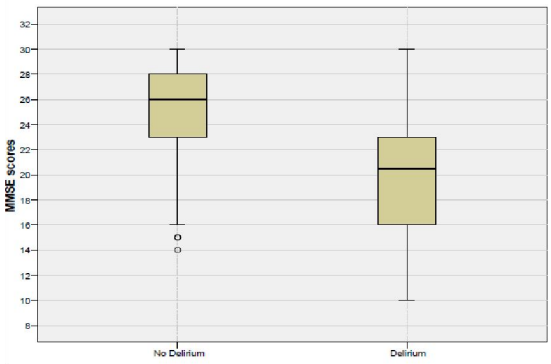

Fig 1:Boxplot: MMSE scores in delirium(n=36) and non-delirium (n=113) group

Median test $\chi^2 = 33.161$, df = 1, $p < 0.00$

Box plot (Fig.1) revealed the MMSE score distributions. The median scores were significantly higher in the non-delirium group

compared to delirium group ($p < 0.001$).

Table 3: Logistic Regression: DSM-IV TR diagnosis as the dependent variable

	Exp (B)	p	95% CI	
MMSE score	0.769	< 0.001	0.696	0.850
Constant	109.13	< 0.001		

$\chi 2$ (7) = 26.147; p = 0.0001

Multivariable logistic regression using Backward Likelihood Ratio method with p value of 0.05 for entry and 0.1 for removal from the model was applied. Age (in years) and MMSE score were the independent variables and a diagnosis of delirium by DSM-IV TR was the dichotomous outcome variable.

The MMSE predicted delirium correctly in 77.9% cases. Further, it was found that for each unit increase in the MMSE score, the odds of getting the diagnosis of delirium are reduced by 76.9%.

Discussion

Delirium has remained an overlooked[8] or an understudied[17] entity in Indian studies, despite its tremendous clinical significance. Out of 149 cases of suspected delirium referred from various specialties of tertiary care hospital, 36 (24.2%) were identified to have delirium by a psychiatrist using DSM-IV-TR. Most western literature has reported a prevalence of delirium to be between 10-30% of medically ill in-patients.[15]

The present study attempts to assess the usefulness of MMSE for detection of delirium in Indian patients, using DSM-IV TR diagnosis as gold standard. This study shows that the sensitivity of MMSE (<24) against DSM-IV-TR was 0.805. Similar to other studies, the correction of MMSE scores has not been done for age and educational background[7,12,18] Clinically, a cut off score less than 24 was found to be appropriate in present study. The ROC analysis, however, suggested a slightly different optimum cut of 24.5, similar to that reported by a previous study.[17] The specificity would have increased up to 0.76 if a cut-off of 22.5 was chosen, however it would have resulted in a considerable decrease of the sensitivity i.e. 0.72. Since a screening instrument should have higher sensitivity, therefore, a cut off score of 24.5 is more appropriate.

Global cognitive decline is a central feature of delirium [1] and MMSE is one of the foremost instruments to pick it up, since it has a ceiling effect. Franco et al[18] looked closely at the relation between cognitive status, assessed by MMSE and delirium diagnosed using Spanish version of DRS-R-98 among 291 geriatric patients in medical wards. The incidence of delirium was 11.7%, and 28.2% had cognitive deficits on MMSE, as against 41% patients in present study. As cognitive status worsened, the risk of a diagnosis of delirium increased linearly, and for each unit of MMSE worsening, the DRS-R-98 severity score worsened 0.4 points. The prediction of a diagnosis of delirium was found to be true in present study as well, which had a younger sample.

The present study found a positive relation between change in MMSE score and risk of delirium diagnosis. The MMSE predicted delirium correctly in 77.9% cases. For each unit increase in MMSE score, the odds of getting delirium were reduced by 76.9%.It denotes that even mild changes in cognitive screening tool increased risk for diagnosis of delirium. In this study, 32 patients having MMSE score less than 24 did not receive a DSM-IV TR diagnosis of delirium. Khurana et al [7] reported similar findings, where more than half of non-delirious patients also scored less than 24. Low scores of the non-delirious patients may suggest a pre-existing cognitive impairment due to a medical, neurological, psychiatric illness or any other

causes. This limits the use of MMSE in diagnosing delirium. Only one case was detected as false negative at an optimal cut-off score of 24.5 for MMSE, which supports the fact that MMSE is good screening tool to detect delirium (cognitive decline).

The study is limited by a cross-sectional design, relatively small sample of delirium cases, absence of sub-classification of type of delirium and non-correction for age and education. The study found the Mini Mental state examination (MMSE) to be suitable as a short and quick screening tool for detection of delirium in Indian sample, however it is not suitable to make diagnosis with DSM-IV-TR as gold standard. Furthermore, even mild changes in cognitive functioning evident on MMSE increases the risk for a diagnosis of delirium.

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