Original Article

Underdiagnosis of delirium on admission and prediction of patients who will develop delirium during their inpatient stay: a pilot study

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INTRODUCTION The study aimed to determine the prevalence and documentation of delirium among the elderly and if the Clock Drawing Test (CDT) can be used to predict which patients had delirium on admission and those who may develop delirium during their stay in acute medical wards.
METHODS A single researcher performed the Mini-Mental State Examination (MMSE) and CDT on admission and discharge of 57 elderly adults at the National University Hospital, Singapore. Delirium was defined as a ≥ 3-point improvement or ≥ 2-point decline in MMSE scores from admission to discharge, where a fall denotes development of delirium and a rise denotes resolution. The case notes of the same patients were reviewed for documentation of delirium. All inpatients from two acute medical wards were examined. One CDT score and a pair of MMSE scores were collected from each patient.
RESULTS A total of 57 patients (28 male, 29 female) were involved in the study. Their mean age was 76.0 ± 8.7 years. The prevalence of delirium based on MMSE scores was 40.4%; 16 patients had delirium on admission while seven developed delirium during their inpatient stay. However, delirium was documented in the case notes of only 7 (30%) of the 23 patients. CDT score was better than baseline MMSE score at predicting a decline in MMSE score.
CONCLUSION The prevalence of delirium in the acute medical setting is high but underdiagnosed. The CDT may be a good screening tool to identify patients at risk of delirium during their inpatient stay. Baseline cognition screening should be performed in every elderly patient admitted to hospital.

Keywords: clock drawing test, cognitive impairment in medical wards, delirium, elderly inpatients

INTRODUCTION

Delirium, defined by O'Keeffe as a ≥ 3-point improvement or ≥ 2-point decline in Mini-Mental State Examination (MMSE) scores from admission to discharge, where a fall denotes development of delirium and a rise denotes resolution,[1] is a reversible mental disorder that is often caused by multiple factors.[2,3] Proper identification and treatment can prevent increased healthcare costs,[4-6] prolonged hospital stay[5] and increased likelihood of placement in a nursing home on discharge.[7,8] Studies on delirium conducted in the hospital setting have found that it is the single most common acute mental disorder among hospitalised elderly patients.[9-11] Prospective studies of medical inpatients in Western countries reported a prevalence of delirium (i.e. existing cases on hospital admission) of 12%–31%[12,13] and incidence rates (i.e. new cases arising during the hospital stay) of 3%–25%.[5,14] It has also been reported that about 30% of elderly patients experience delirium at some time during hospitalisation.[15,16] Despite its frequent occurrence and significant consequences, delirium is often underrecognised. It is not detected by healthcare personnel in up to 70% of patients[17] and is often unrecognised on hospital admission.[18]

We hypothesised that the primary team often misses the diagnosis of delirium when managing elderly patients admitted to the acute medical ward. This study aimed to determine the prevalence and rate of underreporting of delirium among elderly patients admitted to the acute medical wards of a tertiary hospital in Singapore, and to compare the ability of two cognitive screening tests, the MMSE and the Clock Drawing Test (CDT), to predict the development or resolution of delirium during hospitalisation.

METHODS

A single researcher conducted the MMSE and CDT for 57 patients aged ≥ 60 years who were admitted to two acute medical wards in the National University Hospital, Singapore, in June 2011 and June 2012. The MMSE was performed within 24 hours of admission and discharge, and the CDT was performed within 24 hours of admission. Patients were excluded if they were uncommunicative, had a severe hearing impairment or were discharged within 24 hours of admission.

The MMSE is a 20-item test that screens for cognitive impairment.[1,19] It has a total score of 30 points. The items are clustered into 11 subscores measuring orientation to time (maximum possible score [max] 5), orientation to location (max 5), immediate recall (max 3), attention and calculation (max 5), delayed recall (max 3), naming (max 2), verbal repetition (max 1), ability to follow a three-stage command (max 3), reading (max 1), writing (max 1) and figure-copying

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Table I. Summary of changes in Mini-Mental State Examination (MMSE) scores on discharge and case note documentation on the patients (n = 57).

	No. (%)							
	Normal MMSE score (n = 26)[†]				Abnormal MMSE score (n = 31)[†]			
	Improved by ≥ 3 points	Remained equivocal	Worsened by ≥ 2 points	Total	Improved by ≥ 3 points	Remained equivocal	Worsened by ≥ 2 points	Total
Change in MMSE score	2 (7.7)	21 (80.8)	3 (11.5)	26 (100)	14 (45.2)	13 (41.9)	4 (12.9)	31 (100)
Clinical documentation of cognitive impairment*	0	3	1	4	3	6	4	13
Clinical documentation of delirium	0	1	0	1	1	3	2	6

*Includes dementia. †Defined using MMSE scores and educational level cutoffs.

(max 1). Cognitive impairment was defined using MMSE scores and education-adjusted cutoffs[20] of < 21 points for patients with < 6 years of education, < 23 points for patients with 6–12 years of education and < 24 points for patients with > 12 years of education (Appendix I).

For the CDT, we used the scoring method adapted by Shulman et al from Cahn et al.[21-24] The instructions given to the patients and scoring system used (range 1–5, with 5 being normal) are shown in Appendix II. Although a cutoff score of ≤ 3 out of 5 was recommended by Shulman et al[24,25] as an indicator of cognitive impairment, local research has found that a cutoff score of ≤ 4 out of 5 was more appropriate.[26] We did not use the CDT as the primary measure of delirium because it has not been validated by any study as a tool to detect delirium. Instead, we compared it with the MMSE as a cognitive screening test at admission to predict the development or resolution of delirium during hospitalisation, using O'Keeffe et al's definition.[1] The primary team made the diagnosis of delirium mainly through clinical assessment of the patient. The case notes and discharge summaries of each patient were reviewed retrospectively for documentation of cognitive impairment and/or delirium.

Demographic and clinical characteristics of the patients that involved categorical variables were summarised using counts and percentages. For continuous variables, mean and standard deviation were used to describe the data distribution. The primary outcome variable was the development or resolution of delirium during hospitalisation and was based on O'Keeffe et al's definition of either (a) an improvement in MMSE score by ≥ 3 points to detect resolution of delirium; or (b) decline in MMSE score by ≥ 2 points from admission to discharge to detect development of delirium.[1] A change in MMSE score between −1 and +2 is considered equivocal. We used the chi-square test to examine the association between cognitive status on admission (measured by MMSE/CDT score) and change in MMSE score on discharge, as well as the association between change in MMSE score on discharge and re-admission rates up to three months after discharge. We examined the independent associations of CDT and MMSE scores at admission compared to change in MMSE score on discharge using logistic regression. All statistical analyses were generated using IBM SPSS Statistics version 20.0 (IBM Corp, Armonk, NY, USA), using a two-sided test at a 5% level of significance.

RESULTS

A total of 57 pairs of MMSE scores were collected from 28 (49%) male and 29 (51%) female patients. Their mean age was 76.0 ± 8.7 years and the mean length of hospital stay was 6.0 ± 3.3 days. On admission, 26 (46%) of the 57 patients had MMSE scores within the normal range, while 31 (54%) patients had impaired MMSE scores (Table I).

On discharge, regardless of their cognitive state on admission, the MMSE scores of 16 (28.1%) patients had an improvement of ≥ 3 points and 7 (12.3%) patients had a decline of ≥ 2 points (Table I). Hence, based on the criteria for delirium, 23 (40.4%) patients had either developed delirium or recovered from delirium during their hospital stay. Of the 31 patients who had cognitive impairment on admission (i.e. abnormal MMSE scores), 14 (45.2%) patients improved by ≥ 3 points, 13 (41.9%) remained equivocal and 4 (12.9%) worsened by ≥ 2 points. Out of the 26 patients who had no cognitive impairment on admission (i.e. normal MMSE scores), 2 (7.7%) patients improved by ≥ 3 points, 21 (80.8%) remained equivocal and 3 (11.5%) worsened by ≥ 2 points. Of the 23 patients who improved by ≥ 3 points or worsened by ≥ 2 points, only 3 (13.0%) patients had documentation of delirium in their case notes. Mean MMSE scores on admission for the three groups of patients whose score worsened, was equivocal or improved were 19.7 ± 7.9, 23.6 ± 4.3 and 17.9 ± 5.2 points, respectively, while mean MMSE scores on discharge were 16.0 ± 7.6, 24.5 ± 4.4 and 22.9 ± 6.0 points, respectively.

Among the 16 patients who had a CDT score of 0–3 points on admission, 4 (25.0%) worsened by ≥ 2 points, 6 (37.5%) remained equivocal and 6 (37.5%) improved by ≥ 3 points in their MMSE scores on discharge (Table II). Among the six patients who had a CDT score of 4 points on admission, 1 (16.6%) worsened by ≥ 2 points, 2 (33.3%) remained equivocal and 3 (50.0%) improved by ≥ 3 points in their MMSE scores on discharge. Among the 25 patients who had a CDT score of 5 points on admission, 2 (8.0%) worsened by ≥ 2 points, 20 (80.0%) remained equivocal and 3 (12.0%) improved by ≥ 3 points in their MMSE scores on discharge.

Logistic regression analysis adjusted for age, gender and ethnicity showed that normal cognition, assessed according to the patient's MMSE score on admission, was a predictor of absence of delirium or resolution of delirium during the hospital stay, i.e. an equivocal change in MMSE score (odds ratio [OR]

Table II. Relationship between Clock Drawing Test (CDT) score on admission and change in Mini-Mental State Examination (MMSE) score on discharge.

CDT score on admission	Change in MMSE score on discharge (n = 47)*			
	Improved by ≥ 3 points	Remained equivocal	Worsened by ≥ 2 points	Total
0	1 (50.0)	0	1 (50.0)	2 (100)
1	0	4 (57.1)	3 (42.9)	7 (100)
2	1 (100.0)	0	0	1 (100)
3	4 (67.7)	2 (33.3)	0	6 (100)
4	3 (50.0)	2 (33.3)	1 (16.7)	6 (100)
5	3 (12.0)	20 (80.0)	2 (8.0)	25 (100)

Data presented as no. (%). *Some patients were not able to perform CDT.

Table III. Comparison of Mini-Mental State Examination (MMSE) and Clock Drawing Test (CDT) scores at admission predicting improvement in cognition on discharge.

Dependent variable*	Independent variable	Effect size (95% CI)	p-value
MMSE score improved by ≥ 3 points	CDT score on admission	0.13 (−0.44 to 0.70)‡	0.659
	No cognitive impairment vs. cognitive impairment†	0.74 (0.10 to 0.57)§	0.012
MMSE score worsened by ≥ 2 points	CDT score on admission	−1.15 (−2.26 to −0.03)‡	0.045
	No cognitive impairment vs. cognitive impairment†	12.1 (0.16 to 911.93)§	0.258

*Reference category is the group of patients whose MMSE scores remained equivocal on discharge. †Defined using MMSE scores and educational level cutoffs. ‡Beta coefficient reported. §Odds ratio reported.

0.74, 95% confidence interval [CI] 0.10 to 0.57, p = 0.012). CDT score on admission in itself was not a predictor of delirium during the hospital stay (ß = 0.13, 95% CI −0.44 to 0.70, p = 0.659) (Table III). However, a lower CDT score on admission was a predictor of worsening MMSE score (ß = −1.15, 95% CI −2.26 to −0.03, p = 0.045), while a lower MMSE score on admission was not a predictor (OR 12.1, 95% CI 0.16 to 911.93, p = 0.258).

DISCUSSION

In our study, the prevalence of delirium was 28.1% on admission to the acute medical ward and 12.3% of the patients developed delirium during their stay. This is comparable with international data from well-established hospitals, which showed that the prevalence of delirium in medical inpatients on admission was between 12% and 31%,[12,13] and the development of delirium during admission was 3%–25%.[5,14] However, less than one-third of the patients who had delirium in the present study were documented to have this condition, suggesting that delirium is often overlooked in the day-to-day care of elderly patients admitted to acute medical wards. Previous studies have found that delirium is overlooked in up to 68% of patients.[27] It has been reported that untreated delirium increases mortality rates up to three-fold, increases the chance of discharge to nursing home and increases long-term cognitive impairment by up to ten times.[5,12,28,29] As age is a major predisposing factor for delirium, failing to diagnose delirium will increase the economic burden of caring for elderly patients in Singapore's ageing population.

Our study also showed that a normal MMSE score at admission was a better predictor than the CDT score of the absence of delirium during hospitalisation. On the other hand, a lower CDT score was better than the MMSE score in predicting patients whose MMSE score would worsen on discharge. Our findings suggest that the CDT is a good screening tool to detect those at high risk of developing delirium during their inpatient stay. However, this finding should be confirmed by a larger study using a gold-standard diagnostic tool for delirium, such as the Confusion Assessment Method.[8]

The strength of this pilot study was that the data was collected by a single researcher, hence reducing random error and interviewer bias. Its limitations were the small sample size and lack of correlation with the use of catheters and restraints, anticholinergic burden of medications in patients, and underlying function or principal diagnosis for admission. In addition, the correlation between these methods of measuring cognitive changes and the Confusion Assessment Method was not assessed. The test-retest reliability of the MMSE as a screening tool may also be a concern; however, studies have shown that the amount of change in MMSE score was small, usually less than 2 points.[30] Another major limitation of the study is that MMSE scores could have remained equivocal (i.e. did not change) for the patients who were delirious at admission and remained so at discharge.

Our study confirmed that the prevalence of delirium is 40% among older adult inpatients admitted to acute medical wards, and that delirium was overlooked in 70% of these patients. Interestingly, we found that the CDT is better at predicting patients who will develop delirium during their inpatient stay than the baseline MMSE. We found no statistical difference in terms of length of stay and re-admission rates between those with normal or impaired MMSE scores. As delirium is often overlooked by medical professionals but is an important prognostic indicator, all older adults admitted to acute hospitals should be screened for underlying cognitive impairment and delirium. Further larger-scale studies are required to evaluate if the CDT can be used as a screening tool to identify older adults at risk of developing delirium in hospitals.

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APPENDIX

Table I. Education-adjusted cutoff scores using Mini-Mental State Examination scores to define cognitive impairment.

No. of years of education	Cutoff score
< 6	< 21
6–12	< 23
> 12	< 24

Table II. Instructions and scoring system for the Clock Drawing Test.

Instructions	Scoring system
Draw a big circle	• 1 point
Fill in the numbers of the clock	• 1 point for correct numbers written • 1 point for correct positioning of the numbers
Draw in the hands of the clock for ten past 11	• 1 point if two hands of the clock were drawn • 1 point for the correct time