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Original Article

Psychiatry/Mental Health Section

Application of Clock Drawing Test in Evaluating Different Types of Dementias (Alzheimer's Disease, Vascular Dementia and Fronto-temporal Dementia): A Cross-sectional Observational Study

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ABSTRACT

Introduction: The Clock Drawing Test (CDT) is a highly effective screening tool for assessing cognitive function. It complements the Mental State Examination (MSE) in the early detection of various types of dementia and the evaluation of cognitive functions. Documenting the specific type of error in clock drawing significantly enhances the clinical evaluation of dementia patients in an economical manner. The CDT can effectively detect errors in execution and visuospatial functions associated with different types of dementia, including Alzheimer's Disease (AD), Vascular Dementia (VD), and Frontotemporal Dementia (FTD). Additionally, it allows for a comparative analysis of the CDT with the severity of dementia assessed by the Bengal Mental Status Examination (BMSE) Scale.

Aim: Present study aims to determine the ability of the CDT to scriminate these three disorders AD, VD, and FTD by analysing patterns of error in clock drawing.

Materials and Methods: This cross-sectional observational study was conducted at the Department of Neuromedicine, Memory Clinic, Medical College, Kolkata, West Bengal, India, from March 2019 to February 2020. The diagnosis of dementia was made based on the Diagnostic and Statistical Manual of Mental Disorders- Fifth Edition (DSM-V) criteria for AD and VD, and the Rascovsky Criteria for FTD. A total of 80 patients were included in the study, with 40 in the AD group, 30 in the VD group, and 10 in the FTD group, considering 80% power and a 5% probability of error. Dementia severity was assessed using the BMSE [Annexure-III]. The subjects were provided with an 8.5×11-inch blank sheet of paper and a pencil, and were asked to draw a clock, including all the numbers, and set the hands to 10 minutes past 11. They were also requested to copy a clock as accurately as possible from a model. The resulting drawings were then analysed quantitatively by revised scale score and qualitatively using Rouleau's qualitative analysis of clock drawing. Numerical variables were compared between groups using the Analysis of Variance (ANOVA) test and the Wilcoxon test, depending on the distribution's normalcy. All analyses were two-tailed, and $p<0.05$ was considered statistically significant.

Results: When comparing the revised quantitative scale, the CDT score showed a significant difference between the three groups (AD, VD, and FTD) with mean scores of 2.91, 2.9, and 0.7, respectively ($p=0.01$). The size of the drawn clocks also showed a significant difference ($p=0.006$) among the AD, VD, and FTD groups, with sizes of 21.27, 18.63, and 16.7, respectively. The BMSE score also showed a significant difference between AD and FTD ($p<0.05$), as well as between AD and VD ($p<0.05$). Clock size was significantly different between AD and VD ($p<0.05$). There were no significant differences observed regarding graphical difficulty, stimulus-bound response, conceptual deficits, spatial and/or planning deficits, and perseveration among the three groups.

Conclusion: Qualitative analysis of the CDT contributes to the identification of different types of dementia by enabling the description of specific errors. A significant inter-group difference was found in the BMSE score, but it could not pinpoint the domains of cognitive deficits, whereas the CDT can detect those.

Keywords: Cognitive assessment screening instrument, Cognitive disorders, Dementia tests, Mental status

INTRODUCTION

Society is aging globally, and dementia is emerging as a common illness among the aging population [1]. Early diagnosis of dementia by identifying alarming signs may offer clinicians the opportunity to plan and initiate treatment to enhance cognitive functions and improve behaviour [2,3]. Since there are no gold standard tests available for the diagnosis of these diseases, careful clinical evaluation is crucial to differentiate among these disorders [4]. Many cognitive instruments and diagnostic criteria have been developed for evaluating cognitive disorders [5]. The most commonly used tool for assessing cognitive functions worldwide is the Mini-Mental State Exam (MMSE) [6]. The major disadvantage of the MMSE is the language barrier, which may result in a lower score if the local language of the region is not used [7]. The Clock Drawing Test (CDT), as a cognitive screening tool, does not require language performance and also it is merely affected by the individual's education level, which compensates for the shortcomings of the MMSE. The CDT is easy to administer and is less influenced by depression or dysphoria [8,9]. The CDT was initially proposed by Battersby WS et al., as a measure of right parietal dysfunction [10]. Subsequently, the CDT has been widely used as a screening instrument in various studies [11-13]. An ideal cognitive screening instrument should possess the following characteristics: (a) quick administration, (b) acceptable to patients, (c) easy to score, (d) relatively independent of culture, language, and education, (e) good inter-rater and test-retest reliability, (f) high levels of sensitivity and specificity, (g) correlation with measures of severity and other dementia rating scores, and (h) predictive validity [14]. The CDT satisfies all of these criteria and assesses a wide range of cognitive skills [15]. Despite its widespread use, there is no standardised approach to the administration and scoring scale

of the CDT. Clinicians and researchers may ask the patient to draw the entire clock face, known as free-drawn [16], while others may provide the patient with a pre-drawn circle [17]. Some clinicians use clock copying tasks, where patients copy a model; or clock setting tasks, where patients manipulate or draw only the hands on a clock face; or clock reading tasks, where patients have to indicate the time displayed on a clock model [18].

Considering the contribution of the CDT to the identification of cognitive changes and the lack of Indian studies, the CDT has been used to differentiate between AD, VD, and FTD by analysing patterns of error in clock drawing, and a comparative analysis of the CDT with the severity of dementia assessed by the BMSE scale. The secondary objective of this study was to investigate associations with categorical variables such as past medical history (presence or absence of hypertension, diabetes mellitus, dementia, delirium, history of cerebrovascular accident, etc.), and qualitative analysis of clock drawing for inter-group comparison of graphical difficulty, stimulus-bound response, conceptual deficit, perseveration, spatial and/or planning deficit, etc., between the three study groups to detect cognitive changes early.

MATERIALS AND METHODS

The study was a cross-sectional observational study conducted at the Department of Neuromedicine, Memory Clinic, Medical College, Kolkata, from March 2019 to February 2020. The study population consisted of dementia patients attending the memory clinic at Medical College, Kolkata. The diagnosis of AD and VD was made according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) [Annexure-I] [19], and FTD was diagnosed according to the Rascovsky Criteria [Annexure-II] [20].

Sample size calculation: was performed using the following formula: $n=2\ (Z\alpha+Z1-\beta)2\sigma2/\Delta2$, where 'n' represents the required sample size. For $Z\alpha$, Z was a constant set at 1.96, according to the accepted α error of 5% in a two-sided effect. $Z1-\beta$ was set at 0.8, representing 80% power of the study. Assuming a p-value of less than 0.05 as acceptable and a study with 80% power, the following values were obtained: $Z\alpha=1.96$ (using a two-tailed test), $Z1-\beta=0.8$, and a standard deviation of approximately 0.5 based on data from a published paper [21]. For Δ, the authors predicted a 30% improvement in outcomes with the application of the CDT. Therefore, the sample size of the study was calculated as $n=2\ (1.96+0.8416)^2\ (0.5)^2/(0.3)^2=42.32$. But due to the availability of cases during the twelve-month period, a total of 80 patients were recruited for the study, including 40 with AD, 30 with VD, and 10 with FTD.

Inclusion criteria: Patients who presented in the selected study centre during the study time period, were willing to participate in the study, and satisfied the diagnosis of AD,VD by DSM-V specifications and Fronto-Temporal Dementia (FTD) by Rascovsky criteria were included in the study.

Exclusion criteria: The patients with uncorrected visual or auditory impairment, impaired performance in hand movements (significant motor or sensory or ataxic disorders that might confound the effect) and those with gross comprehensive problems were excluded from the study.

All procedures and methods were approved by the Ethics Committee of the Medical College, Kolkata, with reference number MC/KOL/IEC/NON-SPON/223/01-2019 dated 05.01.2019. In the memory clinic, all previously registered patients were seen. The patients were referred from the neurology OPD, psychiatry OPD, general medicine OPD, and sometimes from private practitioners. The memory clinic is jointly run by the Department of Neuromedicine and the Department of Psychiatry, and takes place every Thursday at the Department of Neuromedicine. The patients were assigned to the residents.

Procedure

A detailed history was taken from both the patient and the informant, who is in close contact with the patient. A semi-structured proforma was used to collect the history in the memory clinic. The evaluation of patients in the memory clinic included demographic data (such as age, gender, religion, socio-economic status determined by the modified Kuppuswamy scale [22], education, diet, marital status), vascular risk factors, family history of dementia or psychiatric disease, detailed chronological history, neuropsychological tests [23], modified to include additional items on visuo-spatial ability and language functions, including the BMSE [Annexure-III], general neurological examination, and imaging studies [24,25]. This information was then discussed among the neurologist and psychiatrist to reach a diagnosis according to established criteria.

Only patients with a diagnosis of AD, VD, or FTD were referred to the author without revealing the diagnosis on the second day of the visit. For the clock drawing task, the patients were provided with an 8.5x11 inch blank sheet of paper and a pencil. They were asked to draw a clock, including all the numbers, and set the hands for 10 after 11. After completing this drawing-to-command condition, the patients were asked to copy a clock model as accurately as possible. The model, which contained all the numbers, was three inches in diameter and located on the upper part of the sheet of paper. The hands on the model were set for 10 after 11. The patients were asked to copy the model on the lower part of the same sheet of paper. The resulting drawings were then analysed.

Quantitative assessment: The clock drawings made under the command condition were quantitatively scored according to the Revised Scale Score (RSS) used for scoring clock drawings by Rouleau [Annexure-IV] [26]. Errors on the CDT were categorised based on the integrity of the clock faces (maximum 2 points), presence and sequencing of the numbers (maximum 4 points), and presence and placement of the hands (maximum 4 points).

Qualitative assessment: Both the drawings made under the copy and command conditions were analysed qualitatively. The following dimensions were assessed in the qualitative analysis: size of the clock, graphic difficulties, stimulus-bound response, conceptual deficit, spatial and/or planning, and perseveration. These parameters were based on Rouleau's qualitative analysis [26].

After analysing the clock drawings, the diagnosis of the patients was obtained from the residents. The patients were then grouped into the AD, VD, or FTD group based on their diagnosis. Out of the total 80 patients recruited for the study, 40 were in the AD group, 30 were in the VD group, and 10 were in the FTD group.

STATISTICAL ANALYSIS

Pearson correlation coefficients were calculated to determine the bivariate relationships among continuous variables, such as age, area, socio-economic status, mean years of schooling, etc. Chi-square tests were used to test for associations among categorical variables, such as past medical history (presence or absence of hypertension, diabetes mellitus, dementia, delirium, history of cerebrovascular accident, etc.).

Analysis of Variance (ANOVA) was used to compare numerical variables, including BMSE score, CDT score, clock size (cm), graphical difficulty, stimulus-bound response, conceptual deficit, perseveration, spatial and/or planning deficit, etc., between the three study groups. One-way ANOVA was performed, followed by post-hoc Tukey's test if ANOVA showed significant results. The software used for these analyses were Statistical version 6 (Tulsa, Oklahoma: Stat Soft Inc.) and GraphPad Prism version 5 (San Diego, California: GraphPad Software Inc.).

RESULTS

As shown in [Table/Fig-1], the baseline parameters of the patients (n=80) in the AD (n=40), VD (n=30), and FTD (n=10) groups were

analysed. The mean age in the three groups was comparable, with values of 65.77±8.6 years in AD, 63.2±8.4 years in VD, and 62.6±11.32 years in FTD (p-value 0.389). In terms of gender, approximately 70% (28) of patients in AD were male and 30% (12) were female, 60% (18) of patients in VD were male and 40% (12) were female, and 90% (9) of patients in FTD were male and 10% (1) were female. The distribution of gender was comparable between the three groups.

Parameters	AD (n=40)	VD (n=30)	FTD (n=10)	p-value
Age (years)				
Range	51-89	43-77	43-83	0.389
Mean	65.77±8.6	63.2±8.4	62.6±11.32	
Sex				
Male	28 (70%)	18 (60%)	9 (90%)	0.202
Female	12 (30%)	12 (40%)	1 (10%)	
Area				
Rural	26 (65%)	18 (60%)	6 (60%)	0.899
Urban	14 (35%)	12 (40%)	4 (40%)	
Marital status				
Married	39 (97.5%)	25 (83.3%)	10 (100%)	0.196
Unmarried	0	1 (3.4%)	0	
Widow	1 (2.5%)	4 (13.3 %)	0	
Socioeconomic status*				
Low	19 (47.5%)	12 (40%)	2 (20%)	0.085
Middle	18 (45%)	17 (56.6%)	5 (50%)	
High	3 (7.5%)	1 (3.4%)	3 (30%)	
Education (Completed years of schooling)				
Range	3-15	3-17	2-16	0.609
Mean	8.27±3.8	8.5±4.26	9.5±5.5	
Addiction				
Yes	21 (52.5%)	14 (46.6 %)	6 (60%)	0.612
No	19 (47.5%)	16 (53.4 %)	4 (40%)	
Diet				
Vegetarian	4 (10%)	1 (3%)	0	0.357
Non vegetarian	36 (90%)	29 (97%)	10 (100%)	

[Table/Fig-1]: Descriptive statistics# of demographic parameters.
*Modified Kuppuswamy scale
#Pearson correlation coefficients, analyses were both sided and p<0.05 was considered significant statistically

Regarding the area of origin, 65% (26) of patients in AD were from rural areas and 35% (14) were from urban areas, 60% (18) of patients in VD were from rural areas and 40% (12) were from urban areas, and 60% (6) of patients in FTD were from rural areas and 40% (4) were from urban areas. The distribution of patients from rural and urban areas was comparable between the three groups.

Most of the patients in all three groups were married. The socio-economic status was low in 47.5% (19), middle in 45% (18), and high in 7.5% (3) of patients in AD, 40% (12) were low, 56.6% (17) were middle, and 3.4% (1) were high in VD, and 20% (2) were low, 50% (5) were middle, and 30% (3) were high in FTD. The education level, measured in mean years of schooling, was 8.27±3.8 in AD, 8.5±4.26 in VD, and 9.5±5.5 in FTD, with no significant differences between the groups (p-value 0.697).

Approximately 52.5% (21) of patients in AD were addicted to either alcohol or tobacco, 46.6% (14) in VD, and 60% (6) in FTD, with no significant differences between the groups (p-value 0.612). Regarding dietary history, 10% of patients in AD were vegetarian and 90% were non-vegetarian, 3% of patients in VD were vegetarian and 97% were non-vegetarian, and all patients in FTD were non-vegetarian. There were no significant differences in dietary patterns between the three study populations (p-value 0.357).

Comparing the clinical parameters in [Table/Fig-2] among the three groups (AD, VD, and FTD), no significant difference was found in the prevalence of hypertension (p-value 0.404). The three groups were comparable in this regard. Regarding diabetes mellitus, 12.5% of patients in AD, 26.7% in VD, and 20% in FTD were suffering from diabetes mellitus, and this difference was not statistically significant (p-value 0.321). In terms of low mood, 42.5% of patients in AD, 43.3% in VD, and 10% in FTD reported having low mood. However, the difference between the groups was not statistically significant (p-value 0.136).

Parameters	AD (n=40)	VD (n=30)	FTD (n=10)	p-value*
Hypertension				
Yes	15 (37.5%)	16 (53.3%)	4 (40%)	0.404
No	25 (62.5%)	14 (46.7%)	6 (60%)	
Diabetes mellitus				
Yes	5 (12.5%)	8 (26.7%)	2 (20%)	0.321
No	35 (87.5%)	22 (73.3%)	8 (80%)	
Low mood				
Yes	17 (42.5%)	13 (43.3%)	1 (10%)	0.136
No	23 (57.5%)	17 (56.7%)	9 (90%)	
Past history of CVA				
Yes	0	17 (56.6%)	0	**<0.001**
No	40 (100%)	13 (43.4%)	10 (100%)	
Family history of Dementia				
Yes	1 (2.5%)	7 (23.3%)	0	**0.003**
No	39 (97.5%)	23 (76.7%)	10 (100%)	

[Table/Fig-2]: Clinical Parameters and past medical history between three study population groups.
Chi-square, p<0.05 was considered significant statistically

When assessing the past history of Cerebrovascular Accident (CVA), it was found that there was no past history of CVA in the AD and FTD groups, while 56.6% of patients in the VD group 1 7 (56.6%) patients out of 30 patients were having a past history of CVA. The p-value was <0.001, indicating a significant difference in the past history of CVA among the groups. In terms of family history of dementia, seven patients in the VD group had a positive family history of dementia (p-value 0.003).

From [Table/Fig-3], comparing the BMSE parameters, it can be seen that the mean score was 21.27 in AD, 18.63 in VD, and 16.7 in FTD, which was statistically significantly different between the AD, VD, and FTD groups (p=0.008). Comparing the revised quantitative scale CDT score among the three groups, a significant difference was found (p=0.01), with mean scores of 2.91 in AD, 2.9 in VD, and 0.7 in FTD groups. The clock size was also significantly different (p=0.08) among AD, VD, and FTD, with values of 21.27, 18.63, and 16.7, respectively. There were no significant differences in graphical difficulty, stimulus-bound response, conceptual deficits, spatial and/or planning deficits, or perseveration between the three groups.

Parameters	AD (n=40)	VD (n=30)	FTD (n=10)	p-value
BMSE				
Range in study population	8-25	10-25	8-24	**0.008#**
Mean	21.27	18.63	16.7	
Revised scale CDT score				
Range	0 to 9	0 to 9	0 to 3	**0.01#**
Mean	2.9125	2.9	0.7	
Clock size (cm)				
Range Mean	3.162	3.893	4.15	**0.006#**
Graphical difficulty				
Yes	20 (50%)	15 (50%)	10 (100%)	0.12@
No	20 (50%)	15 (50%)	0	

Stimulus bound response				
Yes	12 (30%)	12 (40%)	7 (70%)	0.67@
No	28 (70%)	18 (60%)	3 (30%)	
Conceptual deficit				
Yes	36 (90%)	29 (96.7%)	10 (100%)	0.357 @
No	4 (10%)	1 (3.3%)		
Spatial and/or planning deficit				
Yes	32 (80%)	27 (90%)	10 (100%)	0.195 @
No	8 (20%)	3 (10%)	0	
Perseveration				
Yes	12 (30%)	12 (40%)	1 (10%)	0.202 @
No	28 (70%)	18 (60%)	9 (90%)	

[Table/Fig-3]: Neurocognitive parameters among the three study populations for BMSE score, revised scale CDT score and of analysing clock drawing.
BMSE: Bengal mental status examination; CDT: Clock drawing test
#Pearson correlation coefficients, @ANOVA followed by post-hoc Tukey's test; Bold p-values are significant

Based on the BMSE score [Table/Fig-4], dementia could be subdivided into three subgroups: mild dementia (BMSE 21-24), moderate dementia (BMSE 13-20), and severe dementia (BMSE <12). In the present study, it was observed that in AD and FTD, the cases were predominantly of mild dementia, with 77.5% in AD and almost 40% in FTD. In VD, the number of cases with mild and moderate dementia were almost equal (mild=43.33%, moderate=40%).

BMSE	AD (N=40)	VD (N=30)	FTD (N=10)
Mild	31 (77.5%)	13 (43.33)	6 (40%)
Moderate	6 (15%)	12 (40%)	2 (20%)
Severe	3 (7.5%)	5 (16.67%)	2 (20%)

[Table/Fig-4]: BMSE Score (maximum=30 and minimum=0) comparison and severity of dementia between three groups.
BMSE: Bengal mental status examination

In [Table/Fig-5], the inter-group comparison showed significant differences in the revised scale score between AD and FTD ($p<0.01$). The BMSE score was also significantly different between AD and FTD ($p<0.05$), as well as between AD and VD ($p<0.05$). Clock size was significantly different between AD and VD ($p<0.05$).

Parameters	Difference in rank sum	p-value#
RSS_AD vs RSS_FTD	24.5	**<0.01**
BMSE_AD vs BMSE_FTD	20.988	**<0.05**
BMSE_AD vs BMSE_VD	13.504	**<0.05**
CSIZE_AD vs CSIZE_VD	3.8296	**<0.05**

[Table/Fig-5]: Inter-group comparison of statistically significant parameters.
RSS: Revised Sclae Score CDT score; BMSE: Bengal mental status examination; C-Size: Clock size
#Kruskla-Wallis ANOVA followed by post-hoc Dunn's test

DISCUSSION

The Clock Drawing Test (CDT) is a valuable tool for early screening of cognitive impairment and can also effective to demonstrate deficits in executive functioning [27]. Diagnosing dementia is important for explaining changes in daily activities, behaviour, intellectual functioning, and mood to patients and their families. Cognitive screening is useful for identifying at-risk populations and those who require further assessment [28]. Early diagnosis allows for early management and the possibility of better functioning. In India, Alzheimer's dementia is the most common form of dementia, and while it primarily presents with memory loss, disturbances in executive functioning often precede memory loss and can be identified using screening tools [29]. The value of cognitive screening depends in the presence of confounding influences that are not directly related to dementia, such as low education, language barriers, and different clinical settings. The Clock Drawing Test (CDT) and the Modified Standardised Examination (BMSE scale in vernacular language) are widely used screening tests for dementia and were used in this study.

It is crucial that the MSE is conducted appropriately, taking into account the subjects and items studied in a specific population and their language and socio-cultural background [30]. The MSE has been translated and modified in various languages. Study data suggests that the carefully modified Bangla version of the MSE, known as the BMSE, is not only effective like other examination scales but also effectively assesses most cognitive domains. Regardless of literacy level, subjects were more comfortable with the BMSE in vernacular language. In this study, the BMSE was adapted to meet two goals: consistency with Bangla cultural contexts and feasibility for use in illiterate and less educated elderly individuals. Significant inter-group differences in BMSE scores were found, and post-hoc analysis revealed significant differences between AD versus VD and AD versus FTD. The BMSE score was higher in AD compared to FTD. However, the BMSE score could not pinpoint the domains of cognitive domains affected [31]. The study also found that even in patients with a high BMSE score, there were deficits in visuo-spatial and/or executive functioning.

The administration of the CDT is easy and simple, and it takes less time compared to the BMSE. Additionally, while observing the patient performing the task, the physician can gather additional information about the patient's planning abilities. The CDT is not as strongly affected by confounding factors such as education and language as the BMSE [32]. The CDT shows good correlation with other screening tests, including the MSE, in most studies [32,33]. In this study, both the CDT and BMSE were used for dementia screening.

In the study, clock drawings were analysed both quantitatively and qualitatively. In the quantitative system, the authors used the revised scale by Rouleau [Annexure-IV]. There were significant differences in CDT scores between groups. Further post-hoc analysis showed that in AD, the CDT score was higher than that in FTD, possibly due to a higher level of apathy in the latter group [34]. For the qualitative analysis of the CDT, the authors studied parameters such as the size of the clock, graphical difficulties, stimulus-bound response, conceptual deficit, spatial and/or planning deficit, and perseveration. Significant inter-group differences were observed in the size of the clock. FTD patients tended to draw bigger clocks compared to AD and VD, while smaller clock sizes were found in most AD patients. In general, the most common errors were conceptual deficits (misrepresentation of time), mild graphic difficulties, and small clock size, respectively. These findings were similar to a study by Fabricio AT et al., [35]. The study showed that in AD and VD, the most common errors were conceptual and planning deficits, while FTD group had a higher frequency of graphical, conceptual, planning, and stimulus-bound response deficits, which was also consistent with a previous study by Fuh JL et al., [36]. The purpose of the qualitative analysis was to differentiate deficits in various neuropsychological domains and categorise different subgroups of dementia based on error patterns.

A review by Tan LP et al., demonstrated the discriminative capacity of the CDT in various forms of dementia [37]. In the majority of studies, the quantitative scores of the CDT were unable to differentiate AD from other patient groups, except for FTD, where the scores were consistently higher than those in AD. On the other hand, qualitative analysis of errors appeared to have discriminative value [38].

Conceptual deficits are particularly informative for identifying different types of dementia, and these errors may not be evident in quantitative CDT scales [39]. Additionally, the present study reported typical errors seen in individuals with limited schooling, such as spatial/planning deficits. The authors also attempted to assess the severity of dementia based on the BMSE score and examine the influence of dementia severity on clock drawing. It was observed that as the

severity increased on the BMSE scale, clock drawing performance deteriorated, especially in conceptual, visuo-spatial, and planning areas. The study found a higher proportion of graphical difficulties, planning problems, and conceptual errors in increasing order from AD, VD, and FTD.

When differentiating AD from VD in the study, AD patients were found to perform better than VD patients in clock drawing. However, the majority of studies have found no significant differences in clock drawing between AD and VD patients [40]. It was also found that VD patients scored lower than AD patients on the CDT. VD patients demonstrated more spatial/planning deficits and graphical difficulties. Frontal executive dysfunction, which is most characteristic in VD, and involvement of the fronto-subcortical circuits responsible for fine motor control and planning are common in VD [41]. The spatial and planning deficits seen in the CDT were more common in VD patients due to subcortical involvement [42]. When differentiating AD and VD from FTD, FTD patients tended to draw a bigger clock compared to AD and VD, while smaller clock sizes were found in most AD patients. The most common errors in AD and VD were conceptual and planning deficits, while graphical, conceptual, planning, and stimulus-bound response deficits were more common in the FTD group [43]. In the future, the combined application of the CDT and MSE will effectively screen for dementia in the aging population.

Limitation(s)

Limitations of the study include language barriers and the time-consuming nature of qualitative analysis. The authors addressed the language barrier by using the BMSE scale in the vernacular language. However, it is important to consider the limitations of the CDT for specific diagnoses and the very early detection of mild cognitive impairment, where additional diagnostic tests are needed.

CONCLUSION(S)

The CDT and MSE in vernacular language, i.e., the BMSE scale, can be effectively used as screening tools for identifying dementia. Qualitative analysis of the CDT contributes to the identification of different types of dementia by describing specific errors. Future studies should explore the contribution of qualitative CDT analysis in samples with various diseases associated with cognitive changes.

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[ANNEXURE-I]

Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM V) criteria, American Psychiatric Association

Mild Neurocognitive Impairment

Cognitive decline one to two standard deviations from normal on formal cognitive testing

Does not interfere with independence

Not due to delirium or other medical or psychiatric disorder

Major Neurocognitive Impairment

Cognitive decline two standard deviations or more from normal on formal cognitive testing

Interferes with independence

Not due to delirium or other medical or psychiatric disorder

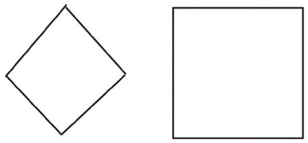
[ANNEXURE-II]

Rascovsky Criteria for diagnosis of Fronto Temporal Dementia

I. Neurodegenerative disease
   A. Shows progressive deterioration of behaviour and/or cognition by observation or history (as provided by a knowledgeable informant).

II. Possible bv FTD (bv=behavioural): Three of the following behavioural/cognitive symptoms (A-F) must be present to meet criteria.
   A. Early behav ioural disinhibition
   B. Early apathy or inertia
   C. Early loss of sympathy or empathy
   D. Early perseverative, stereotyped or compulsive/ritualistic behaviour
   E. Hyperorality and dietary changes
   F. Neuropsychological profile: executive/generation deficits with relative sparing of memory and visuospatial functions

III. Probable bvFTD: All of the following symptoms (A-C) must be present to meet criteria.
   A. Meets criteria for possible bvFTD
   B. Exhibits significant functional decline
   C. Imaging results consistent with bvFTD

Questions	Score
Orientation	
I. Is it morning or afternoon or evening?	1
II. What day of the week is it today?	1
III. What date is it today?	1
IV. Which month is this?	1
V. What season of the year is this?	1
VI. What is the name of this locality/state?	1
VII. In which city does this locality fall under?	1
VIII. What is the name of your city?	1
IX. What is the name of your country?	1
X. Which place or house is this?	1
Registration	
Mango, Chair, Coin	3
Attention	
Days of the week backward	5
Delayed Recall	3
Identification (naming) Watch, pen	1
Sentence repetition: "etao na setao na"	2
Comprehension: Close Your Eyes	1
Ask to pantomime: closing eyes/ may be verbal	1
Three step command	3
Writing	1
Copying 	1

[ANNEXURE-III]

Bengal Mental Status Examination scale (BMSE)

Total BMSE Score: 30

Maximum score: 30

Dementia severity based on BMSE

Mild=20 to 24

Moderate=13 to 19

Severe=≤12

[ANNEXURE-IV]

Scale used for scoring the Clock Drawing using Rouleau et al.,'s

10-point rating scale

Score: 0-1 (total score: min 0-max 10). Task: set the time at 11:10

1. Integrity of the clock face (maximum: 2 points)

   2: Present without gross distortion, 1: Incomplete or some distortion, 0: Absent or totally inappropriate.

2. Presence and sequencing of the numbers (maximum: 4 points)

   4: All present in the right order and at most minimal error in the spatial arrangement, 3: All present but errors in spatial arrangement, 2: Numbers missing or added but no gross distortion of the remaining number, Numbers placed in counterclockwise direction, Numbers all present but gross distortion in spatial layout (i.e., hemi neglect, numbers outside the clock), 1: Missing or added numbers and gross spatial distortions, 0: Absence or poor representation of numbers

3. Presence and placement of the hands (maximum: 4 points)

   4: Hands are in correct position and the size difference is respected, 3: Slight errors in the placement of the hands or no representation of size difference between the hands, 2: Major errors in the placement of the hands (significantly out of course including 10-11), 1: Only one hand or poor representation of two hands, 0: No hands or perseveration on hands.