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Study of progression of mild cognitive impairment in elderly and speech and language assessment in patients of dementia

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Abstract
Background: Mild cognitive impairment (MCI) is often considered as a precursor of dementia but is found to have other outcomes as well. It has variations in presentations including memory complaint, cognitive or behavioral manifestations. It is considered as the appropriate stage for intervention to prevent its progression to dementia and therefore, requires early identification for which various diagnostic modalities such as neuroimaging, neuropsychological tests, and biological markers are considered.
Aims and objectives: To study and analyze the natural history of MCI and cognitive decline in patients complaining of memory impairment.
Materials and Methods: Thirty patients were studied after dividing them into two groups; 10 for the study of MCI and 20 for the study of dementia in the Department of Medicine, MY Hospital Indore (MP). For the assessment of MCI simple battery of psychometric tests including the mini-mental state examination (MMSE) of Folstein, the 15 second version of the Isaac's test (IST) for verbal fluency, the 4- line version of Zazzo's Cancellation test (ZCT) and the 4-item version of Instrumental activities of daily living (4-IADL) (Modified Lawton's scale) were used and the patients were reevaluated at 6 and 12 months with the same battery of test as their baseline assessment. Dementia patients were assessed on various parameters of language and speech and were graded as mild, moderate and severe impairment.
Results: In our survey baseline assessment revealed that participants had deficits in associated learning and naming, subsequent cognitive decline was more precipitous in these individuals who also showed higher relative risk of evolution towards dementia. On all the psychometric tests we found that risk of evolution towards dementia significantly increased after one year. These patients gradually deteriorated on MMSE, and verbal fluency also declined. All 20 patients in our study had word findings difficulty. In comprehension majority (45%) of the cases had mild impairment. 19 out of 20 subjects had reduced verbal fluency, out of which 70% were severely impaired.
Conclusion: Data suggest that cognitive changes can be detected well before onset of Alzheimer disease.

Keywords: dementia, battery, mini-mental state examination, mild cognitive impairment

Introduction
Mild cognitive impairment (MCI) was first defined by Petersen in 2004 [1]. MCI includes individuals who do not meet the criteria for dementia, but have subjective memory complaints greater than expected for their age, combined with objective cognitive decline.
Reports have shown that the annual rate of progression from MCI to dementia is 6–10% in epidemiological studies and 10–15% in clinical materials [2]. Over a 3-year period 20% of MCI cases were diagnosed with dementia, of whom 78% were suffering from Alzheimer's disease (AD) [3].
MCI may increase the risk of later developing dementia caused by Alzheimer's disease or other neurological conditions. But some people with mild cognitive impairment never get worse, and a few eventually get better. [4] MCI has reasonable predictive value and specificity for Alzheimer's disease. MCI is a good predictor of Alzheimer's disease with an annual conversion rate of 8.3% [5].
Hence present study was performed to study and analyze the natural history of MCI and cognitive decline in patients complaining of memory impairment.

Materials and Methods
Present study was carried out in the Department of Medicine, MY Hospital Indore (MP).The study comprises of two groups of patients. First group comprised of patients with mild cognitive impairment. Second group comprised of patients with clinical diagnosis of dementia.

Mild cognitive impairment
It was a survey in which 10 patients aged 60 years and over were recruited and were followed for 1 year. Survey was conducted to observe and analyze the natural history of mild cognitive impairment and cognitive decline in patients complaining of memory impairment. Patient having age≥60 years, patients with a memory complaint (spontaneously or detected by anamnesia), be able to care for himself/ herself and can sign the informed consent form were included.

Patients who were illiterate, meet clinical criteria for dementia at too late stage to enter the survey according to DSM-IV diagnostic criteria, have clinical evidence of major depression, suffer from major hearing loss/ deafness or major visual impairment/ blindness, have a foreign language as their mother tongue and be currently using a prescribed cognition enhancing medications were excluded from the present study.
Subjects who met the inclusion and exclusion criteria were asked to perform a simple battery of psychometric tests including the mini-mental state examination (MMSE) of folstein, the 15 second version of the Isaac's test (IST) for verbal fluency, the 4- line version of Zazzo's Cancellation test (ZCT) and the 4-item version of Instrumental activities of daily living (4-IADL) (Modified Lawton's scale).
The patients were reevaluated at 6 and 12 months with the same battery of test as their baseline assessment.

Dementia
The part of this study comprises of 20 patients having clinical diagnosis of dementia. Speech and language assessment of these patients was done. Comprehension, fluency and grammar, naming, reading, writing, repetition, calculation and speech were assessed for each patient.
Patients with the development of multiple deficits manifested by memory impairment (impaired ability to learn new information or to recall previously learned information), one (or more) of the following cognitive disturbance; aphasia (language disturbance), apraxia (impaired ability to carry out motor activities despite intact motor function), agnosia (failure to recognize or identify objects despite intact sensory function) and patients with disturbance in executive function (i.e. planning, organizing, sequencing, abstracting) were included.
Patients were assessed on various parameters of language and speech and were graded as mild, moderate and severe impairment.
All the data analysis was performed using IBM SPSS ver. 20 software. Cross tabulation and frequency distribution was used to prepare the tables. Data is expressed as numbers and percentage.

Results

Mild cognitive impairment
Majority of the patients were in the age group of 60-65 (40%) and 71-75 years (40%). Majority were educated till 10th class (60%). Out of 10 cases, majority were (6%) from the urban area.

Table 1: Education level

Risk	Education level					
	0-5			10 years and above		
	MMSE	IST	ZCT	MMSE	IST	ZCT
High	≤22	≤20	≤12	≤ 27	≤27	≤13
Medium	=25	=24	=13	=28	=31	=14
Very low	≥27	≥28	≥14	≥29	≥35	≥14

Data is expressed as total score from each test, MMSE; mini-mental state examination of folstein, IST; the 15 second version of the Isaac's test for verbal fluency, ZCT; the 4- line version of Zazzo's Cancellation test

Table 2: Subjects having primary level education and their risk of evolution towards dementia at 0, 6 and 12 months

Risk	Battery of psychometric tests								
	MMSE			IST			ZCT		
	Baseline	6 months	12 months	Baseline	6 months	12 months	Baseline	6 months	12 months
High	0	0	1	0	1	2	3	4	4
Medium	2	3	3	4	3	3	0	0	0
Very low	2	1	0	0	0	0	1	0	0

Data is expressed as number of patient.

MMSE: At baseline 2 patients had medium risk and 2 patients had very low risk of evolution towards dementia. Tat 6 month's assessment 3 progressed to medium risk. At 12 months assessment one patient progressed to high risk and 3 in medium risk and none in very low risk.
IST: All the 4 patients of primary level education were at medium risk of evolution towards dementia. At 6 months one progressed to high risk (25% increase) while after one year two patients progressed to high risk (50% rise in risk after one years).
ZCT: At baseline 3 patients were at high risk (75%) after 6 months all 4 patients were at high risk of evolution towards dementia.

Table 3: Education level more than 10th standard and their risk of evolution towards dementia at 0, 6 and 12 month

Risk	Battery of psychometric tests								
	MMSE			IST			ZCT		
	Baseline	6 months	12 months	Baseline	6 months	12 months	Baseline	6 months	12 months
High	0	2	4	1	1	4	2	2	5
Medium	5	3	1	5	5	2	2	1	0
Very low	1	1	1	0	0	0	2	3	1

MMSE: at baseline assessment 5 patients were at a medium risk (83%) and one at very low risk (16%) and none at high risk. At 6 month 2 patients progressed to high risk i.e. 33% increase at 6 months. After 12 months 4 patients out of 6 progressed to high risk of evolution towards dementia i.e. approx 66% increase in high risk after one year.

IST: 5 patients out of 6 were at medium risk (i.e. 83%) and one patient was at high risk at baseline assessment. After 6 months, risk was same nut after one year, 4 patients progressed to high risk (approx 66% increase in risk)
ZCT: At baseline 2patients were at high risk (33%), the risk increased to approx 80% after 12 months.

Speech and language assessment in dementia
In present study a total 20 subjects having clinical diagnosis of dementia. Most of the patients in the study were from the age group 61-70 years. Majority of the patients were male (60%). Out of 20 patients, 8 were illiterate, rest of the patients were literate.

Table 4: Distribution as per different characteristic of patients with dementia

Characteristic		No of patients	Percentage
Type of dementia	Alzheimer disease	13	65
	Vascular	2	10
	Alzheimer disease + vascular	5	25
Severity of dementia	Mild	9	45
	Moderate	9	45
	Severe	2	10
Verbal fluency	Mild impairment	4	20
	Moderate impairment	1	5
	Severe impairment	14	70
	Normal	1	5
Anomia	Mild	2	10
	Moderate	3	15
	Severe	14	70
	Normal	1	5
Auditory comprehension impairment	Mild	9	45
	Moderate	7	35
	Severe	2	10
	Normal	2	10
Verbal expression	Mild	6	30
	Moderate	6	30
	Severe	6	30
	Normal	2	10
Reading impairment	Letter recognition	11	55
	Word matching	11	55
	Written word picture matching	9	45
	Spoken-written word matching	6	30
	Sentence comprehension	4	20
Writing impairment	Writing on request	9	45
	Serial writing	10	50
	Writing to dictation	2	10
	Visual graphic naming	0	0
	Written information	0	0
Calculation	Simple calculation	10	50
	Difficult calculation	1	5
	None	10	50
Synonym judgment	Synonym judgment	7	35
	Word-non-word judgment	13	65
Speech output	Mildly reduced	7	35
	Moderately reduced	7	35
	Severely reduced	3	15
	Normal	2	10
	Increase	1	5

Data is expressed as number.

Discussion
Any complain of memory impairment deserve attention since it is an indicator of Mild cognitive impairment [6, 7]. Mild cognitive impairment (MCI) describes a state of cognitive functioning that is below defined norms, yet falls short of dementia in severity [8].
At the time of entry into the survey, our patients had subjective complaints about memory but none of them had dementia. These patients were followed at 6 months and 12 months. They were administered a battery of psychometric tests which included MMSE, Isaac's set test of verbal fluency, Zazzo' cancellation test and a questionnaire on instrumental activities of daily living. On all the psychometric tests we found that risk of evolution towards dementia significantly increased after one year. These patients gradually deteriorated on MMSE and verbal fluency also declined. This suggests that cognitive changes can be detected well before onset of Alzheimer disease. Similar work was published by Saxton *et al.* [9]
In Saxton *et al.* study a total of 693 community dwelling individuals, part of the cardiovascular health study, completed a neuropsychological test battery in 91/92. These subjects were followed over the next 8 years. Subjects ultimately diagnosed with Alzheimer's disease had poorer scores on baseline neuropsychological measures than the subjects who remained non-demented. Seventy two individuals were ultimately diagnosed with Alzheimer's disease (median follow up of 4.5 years). [9]
In our survey baseline assessment revealed that participants had deficits in associated learning and naming, subsequent cognitive decline was more precipitous in these individuals who also showed higher relative risk of evolution towards dementia. De Jager *et al.* had similar results in their study over 155 volunteers who were followed for 4 years [10].
When comprehensive assessment procedures are employed, Alzheimer's disease can be predicted with reasonable high accuracy in very mildly impaired individuals [11]. Patients with MMSE≥24 were evaluated annually for at least 3 years. The diagnosis of Alzheimer's disease was confirmed in 98 of 110 (89%) very mildly impaired patients.
Cognitive abilities of older persons range from normal to mild cognitive impairment, to dementia. A study by Bennett *et al.* [12] found that 84% persons with MCI developed Alzheimer's disease, a rate 3.1 times higher than those without cognitive impairment over follow up of 4-5 years. We followed the participants over one year and concluded that there is a gradual decline in the cognitive functions and an increased relative risk of evolution towards dementia.

Language impairment in dementia
Patients with Alzheimer's disease have substantial impairment in many cognitive domen including language processing. The most obvious and best studied language problems in Alzheimer's disease are in production; the frequency and nature of word finding difficulties in Alzheimer's disease has been the subject of research [13].
All 20 patients in our study had word findings difficulty; our findings support previous work on language problem in Alzheimer's disease.

A causal relationship between working memory impairment and language deficits is consistent with other research in both normal and impaired population. Just and Caroenter have argued that individual differences in linguistic working memory capacity underline difference in linguistic performance within normal population. This approach has been extended to Alzheimer's disease patients [14].

Miyake and Crapenter suggested that Alzheimer's disease patients suffer from sever working memory limitation which is the cause of patient's comprehensive deficits [15].

Patients with Alzheimer's disease have difficulty comprehending spoken language [16, 17]. In one study 22 Alzheimer's patients were compared to 17 age matched controls. Alzheimer's disease patients were worse than controls in their comprehension of active and passive sentence. Alzheimer's disease patients were also worse than controls at understanding sentences. This difficulty is apparent in their conversational interaction as well as in their performance in many laboratory tests [18] Our findings are consistent with the previous research work on comprehension, 45% of the cases had mild impairment on auditory comprehension, 35% had moderate impairment while 10% were severely impaired.

Most studies have found that patients with Alzheimer's disease have decreased verbal fluency, Word finding difficulty being one of the major symptoms of dementia. There are wealth of evidence supporting difficulties with word findings, decreases verbal fluency, increased paraphasic errors, circumrotating speech due to anomia and general impairment of discourse all of which worsen over the course of disease [19-21]. In our study 19 out of 20 subjects had reduced verbal fluency. Out of which 70% were severely impaired. This is in agreement with the previous work on verbal fluency, but category fluency was more impaired than letter fluency. Similar results were reported by Gupta *et al*. [22]

In our study grammatical errors were present in 60% of the patients. They took more time accessing the preferred grammatical form. Bates *et al.* argued that this difficult assessing certain grammatical forms in comparable to other language problems in Alzheimer's disease.

Repetition was impaired in 8 of our patients (40%) and that too in patients having moderate or severe dementia, while 12 patients out of 20 performed correctly on repetition tasks. It is reported that repetition is usually preserved in early stages of dementia [23].

Cross sectional nature and small sample size were the main limitations; a large randomized case control trial is need to strengthen the present study findings.

Conclusion

We followed the participants over one year and concluded that there is a gradual decline in the cognitive functions and an increased relative risk of evolution towards dementia. Further evaluation is needed in these patients to fulfill the criteria of dementia. Conventionally defined MCI has reasonable predictive value and specificity for Alzheimer's disease. MCI is a good predictor of Alzheimer's disease with an annual conversion rate of 8.3%.

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