

An observational and cross-sectional study on prevalence of cognitive impairment and short-term changes in cognitive function after ischemic stroke in a tertiary care hospital



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ABSTRACT

Background: Stroke is a leading cause physical and cognitive disability. **Aims and Objectives:** The aims of this study were to investigate the prevalence and pattern of cognitive impairment (CI) after first-ever ischemic stroke. **Materials and Methods:** Sixty subjects with first-ever ischemic strokes, confirmed by magnetic resonance imaging (MRI), were selected. Their clinicodemographic and comorbidity data were collected. Mini mental state examination (MMSE) was done after 3–7 days on each patient. MRI was used to ascertain the side, vascular territory, extent, and neural tissues (cortical/subcortical) involved. CIs were categorized as normal, mild, and moderate-to-severe according to MMSE scores ≥ 24 , 18–23, and 0–17, respectively. Data were summarized as mean \pm standard deviation (SD) for numerical variables and counts and percentages for categorical variables. **Results:** (1) Elderly (61–70 years), male and higher educated patients were more prevalent, hypertension (HTN) was the most common comorbidity. (2) Subcortical, middle cerebral artery (MCA), and anterior cerebral artery (ACA) lesions and non-dominant side involvement were common. (3) 80% patients had CI (65% mild and 15% moderate-to-severe). (4) CI was the most common in patients aged 71–80 years, of lower educational status and having both diabetes and HTN. MCA territory strokes and non-dominant side involvement resulted in more moderate/severe CI. (5) Registration followed by recall was least affected whereas language and praxis were more affected domains. **Conclusion:** Post-stroke cognitive decline is more common in elderly population and patients with lower education. CI is more in people with HTN and DM and in people with MCA territory infarct. Language and praxis were the most affected domain of all.

Key words: Cognitive impairment; First ischemic stroke; MMSE score; Registration and recall; Language and praxis

INTRODUCTION

Stroke, the second most common cause of death in the world is also a leading cause of morbidity.¹ Apart from physical disability, it also causes significant cognitive dysfunction occurring in 10–40% patients after a recent stroke.^{2,3} Aphasia occurring in 21–38% of patients and hemi-spatial neglect are common cognitive dysfunctions.^{4,5} Other disabilities such as impairments in attention,

calculation, visual perception, executive function, and apraxia also occur.

A prospective study from Eastern part of India documented prevalence rate of post-stroke dementia as 13.88%.⁶ The overall prevalence rate worldwide is 7.4%.⁷ In a South Indian study, the pattern of vascular damage and vascular risk factors were evaluated in subjects with vascular dementia.⁸

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Several tests for assessing general and specific aspects of cognitive functions are available, for example, attention and vigilance - digit repetition test, random letter cancellation test, peabody picture vocabulary test; memory function - wechsler memory scale III; abstraction, and higher cognitive function – Wisconsin card sorting test etc.

The mini mental state examination (MMSE) is an easy, comprehensive, and quick way to assess cognitive impairment (CI) at bedside. It is a 30-point questionnaire to assess the presence, severity, and progression of the CI as also the response to treatment.^{6,9} Advantages of MMSE are: No need for specialized equipment or trained personnel and little time to perform. Scores 18–23 indicate mild, 10–17 moderate, and <10 indicate severe CIs, respectively.¹⁰ Hence, we chose MMSE as the tool for assessing cognitive function in subjects with ischemic stroke.

Aims and objectives

Data on post-stroke CI in India are low, particularly after first ever ischemic stroke. The aim of this study is to assess the prevalence and pattern of CI after first ever ischemic stroke.

MATERIALS AND METHODS

A hospital-based, cross-sectional, and observational study was undertaken in Kolkata Medical College and Hospital from January 2019 to July 2020 involving 60 subjects with first ever ischemic stroke who presented to the outpatient department or admitted to the indoor of General Medicine department. Convenient sampling was used. Patients with impaired consciousness, confused state, or inability to comprehend or communicate were excluded from the study. Furthermore, excluded were patients with pre-existing CIs (ascertained from history or pre-existing medical documents) and with the previous history of stroke (hemorrhagic or ischemic). Informed consent was taken in each case. Ethical approval was taken from the Institutional Ethics Committee.

The clinicodemographic and comorbidity (diabetes [DM], hypertension [HTN], and cardiac disease) data were collected using a predesigned proforma. Neuroimaging of brain – magnetic resonance imaging (MRI) – was done in each case to confirm and ascertain the side, site, vascular territory, neural tissue (cortical/subcortical), and extent of the stroke.

MMSE was performed on conscious, cooperative, and communicative patients after 3–7 days of stroke. MMSE, a 30-point cognitive assessment scale, covers orientation (time and space), registration and recall, attention and

calculation, language (naming, repetition, reading, and writing), and visuospatial orientation (copying). Interpretation of MMSE score was as follows:

- a) <24 – Abnormal,
- b) Educational level:
 - <21 abnormal for 8th grade,
 - <23 abnormal for high school,
 - <24 abnormal for graduates or higher,
- c) Severity:
 - ≥24 – No impairment,
 - 18–23 – Mild impairment,
 - 10–17 – Moderate impairment,
 - 0–9 – Severe impairment.

We categorized the MMSE scores of our subjects as normal, mild, and moderate/severe impairments.

Statistical analysis

All data were presented as mean±SD unless otherwise mentioned. Comparisons, if any, was performed by unpaired t-test for quantitative data. For qualitative data, χ^2 was used. $P < 0.05$ was taken as statistically significant to indicate difference between groups. Data analysis was performed using a commercially available statistical analysis software package (SPSS v21, SPSS Chicago IL, USA).

RESULTS

Out of the 70 initially selected subjects, three refused to take part in MMSE, five passed away and two had global aphasia. Final sample size was 60 (age 29–84 years). Data were summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables.

Highest number of patients (31.7%) were in age group (61–70 years), males and college educated patients were more prevalent in our study population. Among comorbidities, HTN alone (41.6%) was the most common followed by HTN and DM together (30%) (Table 1).

Regarding the anatomical distribution of stroke sites, subcortical involvement (56.7%) and middle cerebral and anterior cerebral arterial (MCA+ACA) lesions (43.3%) followed by MCA lesions alone (36.7%) were common. Furthermore, non-dominant involvement (61.7%) was more common in our study.

Regarding the overall severity of CI, most cases (65%) were of mild category and 15% were of moderate/severe category (Table 2).

CI was observed most in 71–80-year age group (all seven out of seven patients), in lower education group (8th grade)

and in patients with both DM and HTN (17 out of 18) compared to those having only one risk factor (Table 3).

MCA territory strokes resulted in most prominent CI (95%). Dominant side involvement produced more total number of CI but a greater number of moderate/severe

involvement was seen in non-dominant side strokes (21.6%) (Table 4).

Least affected cognitive function was registration followed by recall whereas most affected function was language and praxis (Figures 1-3).

Figure 1 shows mean±SD score for attention and calculation is 4.1500±1.0549 and for orientation it is 6.1500±1.2599.

Table 1: Demographic variables

Variables	Frequency	Percent
Age in years		
<40	2	3.3
41–50	11	18.3
51–60	17	28.3
61–70	19	31.7
71–80	7	11.7
81–90	4	6.7
Sex		
Female	23	38.3
Male	37	61.7
Total	60	100.0
Education		
8 th grade	9	15.0
College	31	51.7
High school	20	33.3
Total	60	100.0
Comorbidities		
DM	3	5
HTN	25	41.6
HTN, DM	18	30
Nil	14	23.4
Total	60	100.0

DM: Diabetes, HTN: Hypertension

Table 2: Distribution of involvement of neural tissue (cortical/subcortical), vascular territory, side (dominant/non-dominant), and severity of cognitive impairment (CI)

Variables	Frequency	Percent
Neural tissue involved		
Cortical	26	43.3
Subcortical	34	56.7
Infratentorial	0	0.00
Total	60	100.0
Vascular territory		
ACA	2	3.3
MCA	22	36.7
MCA+PCA	8	13.3
MCA+ACA	26	43.3
PCA	2	3.3
Total	60	100.0
Side of lesion		
Bilateral	8	13.3
Dominant	15	25.0
Non-dominant	37	61.7
Total	60	100.0
Cognitive impairment by MMSE score		
Normal	12	20.0
Mild impairment	39	65.0
Moderate/severe impairment	9	15.0
Total	60	100.0

MMSE: Mini mental state examination, ACA: Anterior cerebral artery, MCA: Middle cerebral artery, PCA: Posterior cerebral artery

Table 3: Association between demographic variables and comorbidities versus MMSE score

Variables	Normal	Mild	Moderate/severe	Total
Age				
<40	1	1	0	2
41–50	2	9	0	11
51–60	6	9	2	17
61–70	3	13	3	19
71–80	0	5	2	7
81–90	0	2	2	4
Total	12	39	9	60
Sex				
Female	4	12	7	23
Male	8	27	2	37
Total	12	39	9	60
Education				
8 th grade	0	4	5	9
College	11	18	2	31
High school	1	17	2	20
Total	12	39	9	60
Comorbidities				
DM	1	1	1	3
HTN	7	16	2	25
HTN, DM	1	10	7	18
Nil	4	10	0	14
Total	13	37	10	60

DM: Diabetes, HTN: Hypertension

Table 4: Association between neural tissue (cortical/subcortical), vascular territory, and side of lesion versus MMSE score

Variables	Normal	Mild	Moderate/severe	Total
Neural tissue involved				
Cortical	4	17	5	26
Subcortical	8	22	4	34
Total	12	39	9	60
Vascular territory				
ACA	0	2	0	2
MCA	1	14	7	22
MCA+ACA	8	16	2	26
MCA+PCA	2	6	0	8
PCA	1	1	0	2
Total	12	39	9	60
Side of lesion				
Bilateral	3	5	0	8
Dominant	2	12	1	15
Non-dominant	7	22	8	37
Total	12	39	9	60

MMSE: Mini mental state examination, ACA: Anterior cerebral artery, MCA: Middle cerebral artery, PCA: Posterior cerebral artery

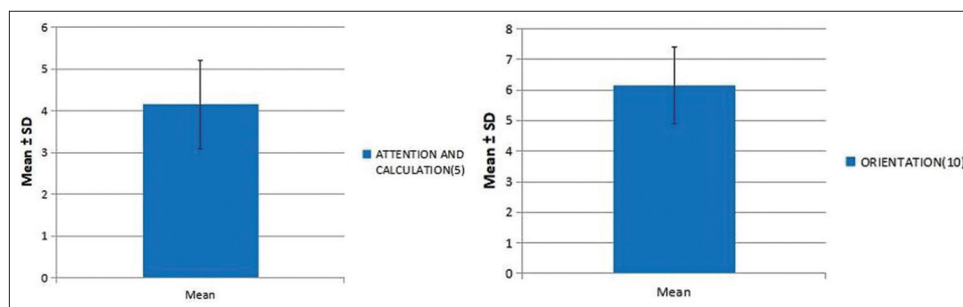


Figure 1: Mean score with standard deviation of attention and calculation and orientation in the study population



Figure 2: Mean score with standard deviation of registration and recall in the study population

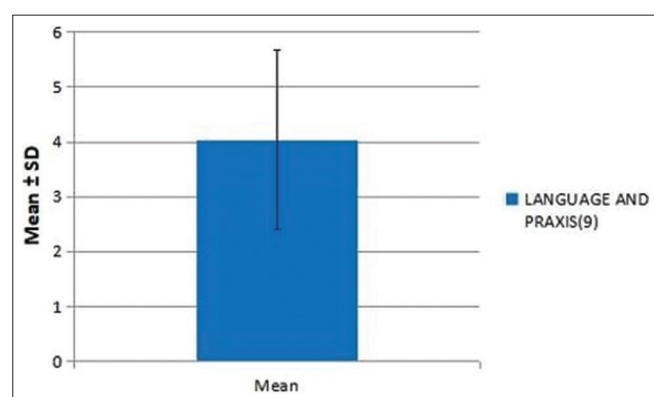


Figure 3: Mean score with standard deviation of language and praxis in the study population

Figure 2 shows mean±SD score for registration is 3.0000±0.0000 and for recall 2.8167±0.5365.

Figure 3 shows mean±SD for language and praxis is 4.0333±1.6361.

DISCUSSION

Sixty patients with first ever ischemic stroke were evaluated for prevalence and pattern of CIs in this study. Clinical assessment and MRI of brain were done and they were subjected to MMSE after 3 to 7 days of onset of stroke.

Patients (age range: 29–84 years, mean – 61.4 years) were stratified into six groups. Most patients belonged to 61–70-year group (32%) followed by 51–60-year

group (28%). CI was most prominent in 71–80-years age group (71% mild and 28% moderate/severe) followed by 61–70-year group (68% mild and 16% moderate/severe impairment). Older age has consistently been reported to increase the risk of post-stroke CI.³

In our study, majority were male subjects (61.7%), females numbered 38.3%. Among males, 73% had mild and 5.4% had moderate/severe impairment. Among females, 52% had mild and 30% had moderate/severe impairment. This finding is in concordance with a study by Akhtar et al.¹¹

We found maximum CI in lower strata of education. Of the 8th grade educated patients, 44.6% had mild and 55.6% had moderate/severe CI. This was followed by high school education group, 85% had mild and 10% moderate/severe CI. The relationship between education and dementia is not straight forward as indicated in a systematic review by Sharp and Gatz.¹² It showed 58% of studies reported significant effects of education on risk of dementia whereas 42% did not.

Comorbidities as important risk factors to ischemic strokes and cognitive decline were evaluated in our study. About 41% subjects had HTN, 5% had DM, and 30% had both. In the last group (both DM and HTN), 55% had mild and 38% had moderate/severe CI. This is in conformity with a study showing the common risk factors of stroke also increase the risk of cognitive decline.¹³

Out of 60 subjects in our study, 39 (65%) had mild, 9 (15%) had moderate/severe, and 12 (20%) had no CI. This

somewhat differs from other studies in this context, for example, one case–control study indicated occurrence of dementia in 19.3% post-stroke cases and another showed development of dementia in 10% after first and 33% after recurrent stroke.^{7,14} This difference may be due to methodological difference and small sample size of our study.

With subcortical stroke, 64% had mild and 12% had moderate/severe impairment, whereas with cortical involvement 65% had mild and 19% had moderate/severe impairment. A study in Japan detected CI (measured by MMSE scale) in 15% patients and was associated with white matter lesions.¹⁵

Maximum CI was observed in MCA territory stroke (63% mild and 32% moderate/severe impairment). Studies have shown prevalence of CI in about half of the patients with an ACA territory circulation stroke and in 1/3rd of lacunar strokes.¹⁶

With dominant side involvement, 80% had mild and 7% had moderate/severe CI whereas with non-dominant side involvement, the figures were 59% and 21%, respectively. Studies had shown higher prevalence of dementia in dominant hemisphere stroke.^{17,18}

Different domains of cognition were analyzed by MMSE scores to have an idea about the maximally affected one after ischemic stroke irrespective of other parameters. We found that maximally affected domain was language and praxis (mean=4.033 in a total of 9). Least affected was registration (mean 3 in a total score of 3) with recall affected very little (mean=2.8167 in a total score of 3). Studies have shown that changes in instrumental activities of daily living requiring complex organizational and problem-solving skills are likely to be more prominent with vascular dementia.¹⁹

Limitations of the study

- 1) Population size of the study was small and time-period was short. Long-term prospective studies with large study population are necessary in this regard.
- 2) We were not able to follow up patients to observe their worsening or improvement.

CONCLUSION

1. Post-stroke cognitive decline was more in elderly subjects, maximum in 71–80-year group.
2. Patients with lower education level (8th grade) had maximum CI.
3. Patients with both DM and HTN had more prevalence of CI (CI) compared to those with only one of the two risk factors.

4. CI was most prominent with MCA territory infarcts (95% had CI).
5. Dominant lobe involvement was associated with a greater number of CI (87%) but non-dominant lobe involvement resulted in a greater number of moderate/severe CI (21.6%).
6. Language and praxis were most severely affected domain (mean 4.033 out of total score of 9). Least affected was registration followed by recall.

RECOMMENDATIONS

1. Larger study population needed to increase the strength of the study.
2. Follow-up period should be longer to observe their cognitive worsening or improvement.
3. A multicenter study will increase the reliability of the study.

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