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Pattern of cognitive deficits in vascular dementia

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***Background & objectives*: There is a paucity of literature on the cognitive profiles of vascular dementia (VaD) in India. The current study was undertaken to investigate the pattern of cognitive deficits in patients with VaD.**

***Methods*: Fifty patients fulfilling the Diagnostic and Statistical Manual of Mental Disorders-IV criteria of dementia and National Institute of Neurological Disorders and Stroke - Association Internationale pour la Recherche et l'Enseignement en Neurosciences criteria for VaD were assessed using Mini Mental State Examination, Kolkata Cognitive Screening Battery and other relevant tests including magnetic resonance imaging of brain.**

***Results*: Twenty patients had small vessel dementia, whereas the least common was haemorrhagic dementia in four patients. In patients with small vessel dementia, apart from memory, all patients had problem in attention and executive function, whereas 12 patients had visuoconstructional deficit and eight patients had language problem. In a total of 12 patients with large vessel dementia, apart from memory, executive dysfunction and visuoconstructional deficit were noted in 10 patients, whereas attention deficit was noted in eight patients. Attention was found to be more involved in small-vessel dementia than large-vessel dementia though all had memory impairment ($P<0.01$).**

***Interpretation & conclusions*: Small vessel dementia was the commonest subtype of VaD in our study. Memory, attention and executive functions were predominantly affected in patients with VaD. Attention was significantly more involved in small vessel dementia than large vessel dementia. Further studies with large sample size need to be done in different regions of the country.**

Key words Cognitive domain - large vessel dementia - small vessel dementia - vascular dementia

After Alzheimer's disease (AD), vascular dementia (VaD) is the second commonest dementia. The prevalence of VaD increases linearly with age and the major risk factors are hypertension, diabetes, heart disease and stroke[1]. Diagnostic criteria for VaD have also evolved over the past two decades and now commonly used criteria are Diagnostic and Statistical Manual of Mental Disorders (DSM IV/V), Alzheimer's Disease Diagnostic and Treatment Centers (ADDTC), International Statistical Classification of Diseases (ICD) and National Institute of Neurological Disorders and Stroke - Association Internationale pour la Recherche et l'Enseignement en Neurosciences (NINDS-AIREN) criteria[2].

VaD is a heterogeneous disease with varied clinical presentation and cognitive profile. The term 'vascular

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cognitive disorder' covers a spectrum, from mild vascular cognitive impairment (VCI) to severe VaD[3]. VaD can be caused by small-vessel, large-vessel or mixed-vessel disease, and classified as large vessel dementia (multi-infarct dementia and strategic infarct dementia), small vessel dementia [subcortical ischaemic VaD (SIVD)], ischaemic-hypoperfusive dementia, haemorrhagic dementia, mixed [usually with Alzheimer's (AD-VaD)] and dementias resulting from specific arteriopathies[4].

It is important to clinically differentiate VaD from AD. In comparison to AD, memory impairment is less striking in VaD, characterized by impaired recall, relatively intact recognition, less severe forgetfulness with greater benefit from cues and more executive dysfunction[5]. Cognitive profiles of different types of VaD also vary with the anatomical distribution of the vascular insults. While small vessel dementia commonly presents with executive dysfunction, large-vessel dementia usually has more visuospatial and language dysfunction[6]. Comprehensive studies on the assessment of cognitive profiles in different types of VaD are lacking, in spite of the high prevalence of VaD in India. This study was aimed to evaluate the various cognitive profiles in different types of VaD and how this pattern recognition could give clues to the underlying vascular disease.

Material & Methods

This cross-sectional hospital-based, observational study was conducted in Medical College and Hospital, Kolkata, India, from January 1, 2014 to December 31, 2016. All patients with VaD attending neurology outpatient department, memory clinic or admitted in wards who consented to participate were selected for the study. The study protocol was approved by the institutional ethics committee and written informed consent was obtained from each participant.

Patients fulfilling DSM-IV criteria of dementia were identified[7]. Among them, patients fulfilling NINDS-AIREN criteria for VaD were selected[2,8]. Subgroups of VaD were classified as small vessel dementia, defined as VaD with evidence of subcortical vascular brain injury with lacunar infarcts (including strategic infarct dementia, where there is selective involvement of eloquent sites) and deep white-matter changes; large vessel dementia, defined as VaD developing after recurrent large-vessel strokes (multi-infarct dementia) or where focal ischaemic lesions involve single branches of large arteries (posterior cerebral artery, middle cerebral artery or anterior cerebral artery) affecting specific sites critical for higher cortical functions (strategic infarct dementia); dementia from both small and large vessel involvement, defined as VaD with brain imaging showing evidence of both small and large vessel involvement and haemorrhagic dementia, defined as VaD resulting from intraparenchymal, subarachnoid or subdural haemorrhage. Mixed dementia (AD-VaD) is defined as dementia resulting from the coexistence of AD and cerebrovascular disease, documented either by clinical criteria or by neuroimaging findings.

Patients having coexisting reversible causes of dementia such as hypothyroidism, thiamine deficiency, vitamin B12 deficiency, normal pressure hydrocephalus, subdural haematoma, chronic infection, brain tumour and drug intoxication were excluded. Patients having coexisting psychiatric disorders such as depression, schizophrenia and conversion reaction and patients with advanced dementia in whom cognitive testing was not possible were also excluded.

Demographic data were collected from the patients, with a semi-structured proforma. General and neurological history was taken with special emphasis on the sequence of involvement of cognitive domains and progression of the disease. Neurological examination was done with special emphasis on the presence of focal neurodeficit, pyramidal and extrapyramidal signs and gait. For cognitive assessment, pre-designed and pre-tested proforma including Mini Mental State Examination (MMSE) and Kolkata Cognitive Screening Battery was used[9,10]. Other cognitive testing tools were also used. For testing attention, forward digit span test and a vigil test were used. For testing visuoperceptual ability, dot counting and fragmented letters were used. Executive function was evaluated. Abstraction was tested using proverb interpretation, similarities. Mental flexibility was tested using trail-making test and go-no-go test. Set-shifting ability was evaluated with graphic Luria (drawing a pattern) and motor luria (palm-fist-edge) test. Planning was tested by clock-drawing test[11,12].

Routine biochemical tests were done including fasting/post-prandial blood sugar; free triiodothyronine (FT3) / thyroxine (FT4) thyroid stimulating hormone, serum vitamin B12 assay and lipid profile. Computed tomography (CT) scan or magnetic resonance (MR) imaging of brain was done. MR angiography brain, digital subtraction angiography brain, single-photon

emission CT brain and ultrasonography duplex neck vessels were done in selected cases.

Statistical analysis: Results were analyzed by SPSS 17 statistical software SPSS (version 17) for Microsoft software (IBM, Illinois, Chicago, USA). Mean and standard deviation calculations were done and analysed by Chi-square test.

Results

One hundred and thirty patients fulfilled DSM-IV criteria of dementia. Sixty patients fulfilled the NINDS-AIREN criteria of VaD. Ten of them were excluded from the study as per the predetermined exclusion criteria. Fifty patients were included in final analysis.

The mean age of the study population was 63.52±9.81 yr and 44 per cent were between 60 and 70 yr of age. Sixty six per cent (n=33) were males. Twenty patients had small vessel, 12 had large vessel and six had small+large vessel dementia. Eight patients had AD-VaD and four haemorrhagic VaD.

Thirty per cent (n=15) patients were diabetic and hypertensive, whereas 44 per cent (n=22) were hypertensive only and 20 per cent (n=10) were diabetic only. In patients with small vessel dementia (n=20), ten were hypertensive, three were diabetic and five were both, while in patients with large vessel dementia (n=12), five were hypertensive, two were diabetic and five were both.

In our study, 25 patients had MMSE score between 18 and 23, but 18 had <18. Mean MMSE score was 18.12±4.74. In patients with small vessel dementia, this was 19.8±4.33, while in patients with large vessel dementia, the score was 18.33±5.51.

All patients had memory problem; executive dysfunction was noted in 48 (96%) and attention problem in 45 (90%) patients. Other cognitive domains involved were language in 22, visuoconstructional in 31 and in visuoperceptual in 14.

In patients with dementia due to small vessel, small and large vessel involvement, and with AD-VaD, memory, attention and executive dysfunction were noted in 100 per cent of cases (Table). All four patients with haemorrhagic dementia had deficit in memory, language and executive function, whereas 75 per cent of patients were noted to have deficit in attention and visuoconstructional tasks (Table). Comparing small and large vessel dementia, all patients had memory involvement, but attention was found to be more involved in small vessel dementia (P<0.01) SPSS 17 statistical software SPSS (version 17) for Microsoft software (IBM, Illinois, Chicago, USA). Executive dysfunction and visuoperceptual deficits were more in small vessel dementia, while visuoconstructional deficit, language problem and calculation impairment were more in large vessel dementia, though not significant (Table).

Discussion

In our study, small vessel dementia was the most common type (40%) of VaD followed by large vessel dementia (24%). Similar to our study, Staekenborg *et al*[13] in a cross-sectional study on 706 patients found that the small vessel dementia was most prevalent (74%), while 18 per cent had large vessel disease and eight per cent had both small and large vessel diseases. Ying *et al*[6] in a study on 402 VaD patients reported 70.4 per cent patients with small-vessel VaD, 24.1 per cent with large-vessel VaD and 5.5 per cent mixed-vessel VaD. They also found hypertension to be the most prevalent risk factor (81%) in patients with VaD[6].

Table. Cognitive domains affected in different subtypes of vascular dementia

Cognitive domain	Small vessel (n=20)	Large vessel (n=12)	Small and large vessel (n=6)	AD with VaD (n=8)	Haemorrhagic (n=4)
Attention	20	8**	6	8	3
Language	8	6	2	2	4
Memory	20	12	6	8	4
Visuoconstruction	12	10	2	4	3
Visuoperception	4	2	2	4	2
Calculation	4	4	2	4	2
Executive function	20	10	6	8	4

**P<0.01 compared to small vessel dementia. AD, Alzheimer's disease; VaD, vascular dementia

In a study comparing small and large vessel dementia using Seoul Neuropsychological Screening Battery, patients with small vessel VaD showed more deficit in calculation (P=0.046), Rey Complex Figure Test-copy time (P=0.014) and phonemic fluency of the Controlled Oral Word Association Test (P=0.049), while patients with large vessel VaD were significantly more impaired than those with small-vessel VaD on Seoul Verbal Learning Test-recognition score (P=0.01)[14]. Comparing cognitive domain involvement in small vessel, large vessel and mixed vessel diseases, Ying *et al*[6] found that besides memory defect, executive function was the most common domain involved in patients with VaD (68.9%), followed by calculation defects (40.5%) and language dysfunction (39.6%). They found that executive dysfunction was more observed in patients with small vessel VaD compared to large vessel and mixed vessel VaD (P<0.05), while patients with large vessel VaD had more involvement of visuospatial and language-verbal domains (P<0.05). In our study, among the cognitive domains, memory, executive function and attention were predominantly involved in our VaD patients. Comparing small and large vessel dementia all patients had memory involvement, but attention was found to be significantly more involved in small vessel dementia in our study. As also observed in the present study, Pohjasvaara *et al*[15] reported that SIVD was associated with predominant working memory deficits, visuomotor speed and executive dysfunction. In a study comparing AD, VaD and mixed dementia (AD-VaD), neuropsychological features of mixed dementia (AD-VaD) were found more closely related to those of VaD than AD[16]. In our study also attention, executive function and memory were involved in all patients of AD-VaD. In a study by Garcia *et al*[17], evaluating cognitive profile in patients with intracranial haemorrhage, cognitive disorders were mainly related with episodic memory (52%), psychomotor speed (44%) and executive function (37%), followed by language and visuoconstructive abilities.

Further studies are required for comparison between each subgroup of VaD. Further, Kolkata Cognitive Screening Battery was used to evaluate cognitive domains, which is only a screening tool. Studies using detailed cognitive neuropsychological test batteries are needed to evaluate cognitive domains more elaborately. Our study was cross sectional and unicentric; hence, there is a need for longitudinal, multicentric studies to support our findings.

In conclusion, our findings showed that small vessel dementia was the commonest subtype of VaD in our patients. Memory, attention and executive functions were predominantly affected in patients with VaD. Attention was significantly more involved in small vessel dementia than large vessel dementia. Further studies are needed, especially in the Indian subcontinent, to evaluate the implications of these findings as a screening tool for early recognition and evaluation of VaD.

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***Conflicts of Interest*:** None.

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