Cognitive profiles associated with intracranial dural arteriovenous fistula

SIR—There are a number of case studies and small case series of intracranial dural arteriovenous fistula (DAVF) associated with cognitive impairment sufficient to amount to a dementia syndrome, with resolution of cognitive deficits following definitive treatment (surgical, endovascular) of the fistula [1–19]. Thus intracranial DAVF is recognised as a rare cause of reversible vascular dementia, through a presumed mechanism of intracerebral venous hypertension. However, accounts of the precise neuropsychological deficits in these patients and serial documentation of cognitive function are largely lacking, most reports focusing on the neuroradiology of the vascular anatomy and endovascular intervention. This may be due in part to the necessity for prompt therapeutic intervention when there is acute neurological deterioration [5], although at least some intracranial DAVF cases are associated with slowly progressive cognitive decline sufficient to suggest an initial differential diagnosis of neurodegenerative dementia [8, 9, 15, 16]. The label of ‘thalamic dementia’ has been used on occasion, based largely on neuroimaging findings of bilateral thalamic involvement [10, 17, 18].

Our experience with three cases of intracranial DAVF [20] has included serial monitoring of cognitive function, either with formal neuropsychological assessment or the Addenbrooke's Cognitive Examination (ACE) [21], a ‘bedside’ test which incorporates the Mini-Mental State Examination (MMSE) [22] and with which we have extensive experience [23]. As the clinical and neuroradiological details of these cases have been previously reported, only the cognitive findings are given here.

Results

Case 1

A 65-year-old man was slow to respond and had difficulty following simple commands when he first presented with an 18-month history of poor memory and declining mobility. MRI revealed abnormally dilated vessels throughout the brain, suggestive of DAVF (Figure 1). Subsequent angiography confirmed an intracranial DAVF arising at the left sigmoid/transverse sinus junction with associated occlusion of the sigmoid sinus, with a second fistula arising at the superior sagittal sinus (Borden type 2 [24]). Neuropsychological assessment was undertaken before and 1 year after endovascular embolisation of both fistulae (Table 1).

Initial assessment with the Mattis Dementia Rating Scale (DRS-2) showed performance in the abnormal range in all five subscales indicative of a significant decline in cognitive function from premorbid estimates based on education and employment history. Wechsler Abbreviated Scale of Intelligence (WASI III) performance for verbal IQ fell within the low average range, in line with estimates of premorbid functioning. On the Wechsler Memory Scale (WMS III), performance on tests of auditory memory was within the extremely low range for immediate, delayed and delayed recognition paradigms, suggesting a significant decline in memory functioning from premorbid levels. Because of long-standing visual sensory difficulties, visual memory could not be assessed. Letter verbal fluency assessed with the Benton Verbal Fluency Test showed performance in the defective range. Overall the assessment showed a significant decline in cognitive functioning compared to premorbid estimates.

One year following endovascular embolisation, DRS-2 continued to show severe impairment in the initiation subtest with evidence of perseveration, but only moderate impairment in construction and memory, mild impairment in conceptualisation and performance within the average range in tests of simple attention. Verbal IQ (WASI III) was essentially unchanged, but auditory immediate and delayed memory indices were within the low average range and auditory recognition within the average range (WMS III), all improved from pre-treatment assessment. Executive function assessed with the Delis Kaplan Executive Function System showed letter and semantic fluency within the average ranges, a significant improvement from the previous performance. Hence, there was evidence for improvement in the areas of simple attention, construction, conceptualisation and especially auditory memory compared to the pre-treatment assessment.

Case 2

This 68-year-old man presented with a 3-month history of deteriorating memory and was noted to have mental slowing when first assessed. Investigations showed bilateral high signal in the basal ganglia on MRI, and angiography revealed an intracranial DAVF arising from the left transverse sinus with associated occlusion of the sigmoid sinus causing retrograde flow within the straight sinus and deep cerebral veins (Borden type 2).

Initially, ACE could hardly be completed because of patient slowness (MMSE 7/30, ACE 10/100). Impairments were evident in all areas, with the possible exception of simple visuospatial abilities (intersecting pentagons, wire cube). However, 1 week after embolisation there was marked improvement in all areas (MMSE 18/30, ACE 51/100), and further improvement was seen at 3 months (MMSE 28/30, ACE 70/100), with normal orientation in time and place although delayed recall of name and address was still at floor. Over 1 year post-treatment his scores were stable (MMSE 23/30, ACE 76/100), with name and address delayed recall now perfect.

Case 3

At initial presentation, this 68-year-old man had a 4-month history of confusion and poor memory. His subsequent investigations disclosed a complex fistula arising from the left
transverse sinus with occlusion of the sigmoid sinus and retrograde drainage to the superior sagittal sinus (Borden type 2). Initial ACE assessment (MMSE 15/30, ACE 41/100) showed impairments in all areas but with relative preservation of language. Marked improvement was seen in all areas at 2 months after staged endovascular embolisation of the fistula (MMSE 27/30, ACE 78/100), but with verbal fluency least improved.

Formal neuropsychological assessment performed 2 years post-treatment showed full-scale IQ of 96 (WASI III), within the average range but reflecting a decline from premorbid levels (WTAR premorbid full-scale IQ 112). On memory testing (WMS III), he was in the low average range on tests of delayed auditory memory, although delayed recognition memory was in the superior range, suggesting an access rather than encoding deficit. Delayed visual memory was in the average range. He was in the high average range on naming (Graded Naming Test) and was normal on the Copy of the Complex Rey–Osterreith Figure. Verbal fluency was below the first percentile.

Discussion

All three patients showed marked improvements in cognitive function following definitive treatment of intracranial DAVF, based on both clinical evaluation and cognitive testing, findings in keeping with previous reports of similar cases [1–19]. Cognitive function improved in all domains, especially memory and executive function, correlated with obliteration of the DAVF and improved cerebral transit time. However, deficits remained evident in memory, which did not return to estimated premorbid levels, and in executive function, with

Table 1. Case 1, serial neuropsychological assessment

<table>
<thead>
<tr>
<th>Time</th>
<th>Pre-treatment</th>
<th>1 year post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRS-2:</td>
<td>87/144</td>
<td>117/144</td>
</tr>
<tr>
<td>Attention</td>
<td>28/37 (severely impaired)</td>
<td>36/37 (average)</td>
</tr>
<tr>
<td>Initiation/perseveration</td>
<td>18/37 (severely impaired)</td>
<td>25/37 (severely impaired)</td>
</tr>
<tr>
<td>Construction</td>
<td>1/6 (severely impaired)</td>
<td>4/6 (moderately impaired)</td>
</tr>
<tr>
<td>Conceptualisation</td>
<td>25/39 (severely impaired)</td>
<td>32/39 (mildly impaired)</td>
</tr>
<tr>
<td>Memory</td>
<td>15/25 (severely impaired)</td>
<td>20/25 (moderately impaired)</td>
</tr>
<tr>
<td>WASI III:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal IQ</td>
<td>87 (low average)</td>
<td>95 (average)</td>
</tr>
<tr>
<td>WMS III:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory immediate</td>
<td>59 (extremely low)</td>
<td>86 (low average)</td>
</tr>
<tr>
<td>Auditory delayed</td>
<td>64 (extremely low)</td>
<td>89 (low average)</td>
</tr>
<tr>
<td>Auditory recognition delayed</td>
<td>65 (extremely low)</td>
<td>95 (average)</td>
</tr>
</tbody>
</table>
respect to initiation (Case 1) and verbal fluency (cases 2 and 3). Thus, although all patients had a reversible dementia syndrome, all showed residual cognitive deficits 1 year or more post-treatment. It is possible that these relate to irreversible changes, such as complete or partial venous infarction of tissues subject to venous hypertension, which was of many months duration in our patients. Venous hypertension has also been implicated in the aetiology of transient global amnesia [25] but presumably for much briefer periods of time, correlating with the generally excellent neuropsychological outcome in this condition.

Unlike the situation with neurodegenerative disorders such as Alzheimer’s disease, frontotemporal lobar degenerations or Huntington’s disease, the expectation that a typical cognitive profile might be associated with intracranial DAVF is not appropriate, since the size, location and drainage pattern of the fistula, and hence of venous congestion and haemorrhage, are recognised to be the key determinants of clinical presentation which varies between patients [26]. Nonetheless, previous cases have been labelled as ‘thalamic dementia’ based on the neuroradiological involvement of the thalami bilaterally [17]. The term ‘thalamic dementia’ dates back some 70 years, when Stern used it to designate the cognitive changes in a case with bilateral symmetrical thalamic degeneration [27]. It has subsequently been used for various thalamic pathologies associated with cognitive impairment [28]. Reported cognitive and neurobehavioural impairments include forgetfulness/amnesia, apathy, with or without language disturbance, hypersomnia and disorders of attention. Other cases have shown extensive white matter change [2, 4, 15]. The label of ‘pseudodementia’ has also been applied [12].

One clinical feature common to all our patients which was not fully captured by the standard neuropsychological and cognitive tests administered to them was the impairment in processing speed, suggestive of subcortical involvement. This may reflect the marked prolongation of cerebral transit time seen with radiological contrast: late angiographic views indicate that venous drainage of brain parenchyma is considerably delayed. In particular, no timed tests were used in these assessments. No standardised cognitive battery has, to our knowledge, been recommended for intracranial DAVF cases. As with other forms of vascular cognitive impairment such as subcortical ischaemic vascular disease [29], use of standard cognitive tests designed to identify the memory deficits of Alzheimer’s disease may not be adequate or appropriate to document fully the impairments in intracranial DAVF cases, particularly executive deficits such as slowed information processing and difficulties with initiation, planning, sequencing and abstracting. Although our studies used different instruments in different cases (DRS-2, WASI III, WMS III, MMSE, ACE), so do not permit us to recommend a particular assessment method, one option might be to use the Vascular Dementia Assessment Scale cognitive subscale (VADAS-Cog), which has evolved from the ADAS-cog and includes tests of mental speed and executive function [30].

Key points

- Intracranial DAVF is a reported cause of reversible vascular dementia, but detailed cognitive profiles have seldom been described.
- Three DAVF patients improved after endovascular embolisation, particularly in attention, memory and executive functions.
- Residual deficits were evident in some cognitive domains even up to 2 years after embolisation.
- Persistent cognitive deficits may be related to irreversible structural changes, such as complete or partial venous infarction of tissues which have been subject to chronic venous hypertension.

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Conflict of interest

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Can IQCODE differentiate Alzheimer’s disease and frontotemporal dementia?

SIR—The differential diagnosis of Alzheimer’s disease (AD) and behavioural variant frontotemporal dementia (bvFTD) may be difficult because the clinical features and diagnostic criteria for these conditions show a degree of overlap [1]. A number of bedside test instruments, examining cognitive, behavioural and/or functional domains, and based on patient or informant report, have been suggested to be helpful in making the distinction between AD and bvFTD [2], but those examined in this clinic have not proved particularly useful, namely the Addenbrooke’s Cognitive Examination VLOM ratio [3], the Instrumental Activities of Daily Living Scale [4] and the Cambridge Behavioural Inventory [5].

The Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) is a widely used screening test for dementia, providing information complementary to cognitive tests [6]. A lower score (range 1–5) represents better performance. As part of ongoing studies of IQCODE in this clinic based in secondary care [7], the utility of IQCODE scores to differentiate AD and bvFTD was examined.

Patients and methods

All cases with diagnoses of either probable AD (using NINCDS-ADRDA criteria [8]) or bvFTD (using Neary criteria [9]) and with IQCODE (long form [10]) performed at the same time as initial clinical and neuropsychological assessments were identified from clinic records over an 18-month period (July 2007–December 2008 inclusive), and IQCODE scores for patients with AD and bvFTD were compared.

Results

As expected, the bvFTD cases (n = 13) had a younger age at diagnosis (range 47–76 years, mean 60.2 +/− 7.3 years) than the AD cases (n = 41; age range 52–92 years, mean 70.6 +/− 9.0 years) and a greater male preponderance (bvFTD M:F = 11:2; AD M:F = 15:26).