Anterograde amnesia with fornix damage following removal of IIIrd ventricle colloid cyst

John R Hodges, Katherine Carpenter

Abstract

Two patients developed anterograde amnesia following the apparently uncomplicated transcallosal-transventricular removal of a colloid cyst. Damage to the fornical columns was demonstrated on CT and MRI scans, whilst other memory related structures were entirely normal. Longitudinal neuropsychological evaluation, over 12-24 months, has revealed a very similar pattern of deficit in the two cases; verbal memory has remained persistently impaired whilst nonverbal anterograde memory has improved to some degree. Formal tests of remote public (famous faces and events) and personal autobiographical memory have supported the clinical impression that neither patient has a temporally extensive retrograde amnesia. These findings address the role of the fornix, and the dissociation of memory processes in humans.

The issues addressed in this paper are threefold. Firstly, the finding of a clinically significant amnesic syndrome in two patients following the apparently uncomplicated transcallosal removal of colloid cysts from the IIIrd ventricle has obvious practical implications for the management of such cases. Secondly, the site of pathology has relevance to the continuing controversy concerning the role of the fornix in human memory. Thirdly, the pattern of memory deficit, with partial recovery of non-verbal anterograde memory and the absence of appreciable retrograde amnesia in either case, addresses the issue of the dissociation of memory processes, particularly the relationship between anterograde and retrograde memory loss in the amnesic syndrome.

Case reports

Case one

A 45 year old right handed woman, presented in July 1985 with a 12 month history of severe paroxysmal bursting headaches, associated latterly with brief episodes of paraesthesia and weakness affecting the left leg. She had no complaints of memory loss, and had continued working as a clerk and running her house without difficulty. Her family had noted no problems with her memory or other higher cognitive function. Physical examination revealed no abnormalities. Bedside testing of orientation, attention, memory and language was normal. A CT scan revealed a typical high density non-enhancing colloid cyst situated in the anterior part of the IIIrd ventricle with a mild degree of obstructive hydrocephalus. Surgery was performed in July 1985. A transcallosal approach to the left lateral ventricle was used. A 2 cm incision was made in the corpus callosum. The pericallosal arteries were identified and spared. A typical tense colloid cyst was identified embedded in the septum pellicum which was opened. The cyst was then removed via the left foramen of Munro without apparent damage to the fornices. There were no operative complications and the patient’s recovery in the immediate post-operative period was uneventful.

Upon recovery, it was immediately apparent that she had developed an amnesic syndrome with anterograde memory impairment so that she was unable to retain simple verbal material (for example, name and address) for more than a few minutes and was disorientated in time. The retrograde amnesia initially covered the last 12 months. For instance, she was unable to recall the operation, preceding illness or family events of the past year. Over the next few months, however, the retrograde amnesia gradually decreased to approximately four weeks in duration. Detailed and repeated informal assessment of remote memory, for both personal and public events, from the past two decades has shown consistently excellent performance.

Although there has been no improvement in the degree of anterograde memory impairment during the two years since her surgery she has adjusted well to the handicap by the extensive use of mnemonic devices, and retains good insight into her memory capacities. In 1986 she returned to work at her former employment but in a sheltered part-time capacity.

Formal neuropsychological testing was carried out at one, three, 14 and 24 months post operatively (see below). A CT scan performed following surgery showed an area of low attenuaton in the region of the left fornical column (fig 1a). A recently obtained MRI brain scan, with contiguous parasagittal T1 weighted images, demonstrated severance of the fornices at the level of the IIIrd ventricle directly beneath the deficit in the anterior corpus callosum (fig 2a). Both scans failed to reveal any abnormalities in other major memory-related structures (that is, the thalamus, the hippocampus and parahippocampal regions). Figure 3 illustrates the normal appearance and course of the fornix in a control subject for comparison.
Figure 1  Axial CT scan images in cases 1 (1a) and 2 (1b) at the level of the foramen of Munro showing an area of low attenuation in the region of the left fornical column (arrow).

Case Two
A 33 year old right handed man, presented in May 1987 with a three month history of paroxysmal headaches and a single episode of loss of consciousness. At this time he continued to work as a self-employed salesman without difficulty. His wife had not noticed any impairment in his memory. Physical examination revealed no abnormalities. Bedside testing of attention, orientation, memory, visuospatial function and language was normal. A CT scan revealed a typical high density non-enhancing cyst situated in the anterior part of the IIIrd ventricle, approximately 1 cm in diameter. There was minimal enlargement of the lateral ventricles.

Surgery was performed in May 1987. The cyst was removed by a transcallosal approach to the left lateral ventricle, a technique identical to that used in case 1. A 1 cm incision was made in the corpus callosum. The pericallosal arteries and thalamo-striate vein were identified and spared. The septum pellucidum was then opened and a typical colloid cyst was identified through the foramen of Munro. The cyst was incised and evacuated, the capsule was then dissected away from the fornical columns and completely removed via the left lateral ventricle. There were no complications in the immediate post-operative period.

As soon as he had recovered from the procedure it was apparent that he had developed an amnestic syndrome with clinically obvious anterograde memory impairment but temporally limited retrograde memory loss. Initially the retrograde amnesia was of approximately 18 months duration; he was unable to recall his operation, presenting complaints or loss of consciousness.

Figure 2  Sagittal MRI images in cases 1 (2a) through the midline showing interruption of the fornices (arrow) at the level of the foramen of Munro directly beneath the surgical corpus callosum defect. In case 2 (2b) the right fornical column was apparent on contiguous parasagittal cuts, but in the other patient neither column could be demonstrated.

Figure 3  Midline sagittal MRI image in a control subject showing the normal appearance and course of the fornix (arrow) for comparison with the two patients.
family events over this period. Over the next few months, however, the retrograde amnesia gradually shrank to about four weeks. As in the former case, his recall of more remote personal and public events has remained normal on detailed informal testing.

The degree of anterograde memory impairment, apparent on clinical testing, had not improved substantially when last reviewed 12 months post-surgery. He does, however, retain very good insight into his memory capacities and by the use of extensive written and recorded notes has managed to return to work in an office but with a substantial reduction in status and salary.

A CT scan performed post-operatively (fig 1b) revealed a lesion in the region of the left anterior column of the fornix, and residual enlargement of the left lateral ventricle. A recently obtained MRI scan, using the same techniques as above, showed interruption of the left fornical column beneath the surgical deficit in the corpus callosum at the level of the foramen of Munro (fig 2b). No other lesions were shown.

### Results

The formal neuropsychological test results on cases 1 and 2 are shown in tables 1 and 2, respectively. The patients' scores were compared with established normative data for tests in routine clinical usage. For the more experimental tests, normative data were derived from 2 neurologically normal controls subjects, mean (SD) age 54.2 (8.6), who represent a subgroup of the community-based controls used in a previous study.8

The results confirmed the presence of an amnesic syndrome which initially affected anterograde verbal and nonverbal memory to an equal degree. In Case 2 there was no significant discrepancy between the estimated level of pre-morbid IQ, as judged by performance on the National Adult Reading Test (NART) and the post-operative WAIS IQ scores. Case 1 showed a discrepancy between Verbal and Performance IQ of 23 points in favour of the latter, implying a degree of verbal intellectual impairment. A number of additional tests of general cognitive ability (Raven's Advanced Progressive Matrices), frontal executive function (trail making, verbal fluency9), problem solving10 and naming11 revealed no evidence of impairment in either patient (see table 3). Immediate (short-term) memory for verbal material (digit span) and non-verbal material (Corsi block tapping span) was also normal.

Assessment of longer-term verbal memory revealed substantial impairment which has persisted without significant improvement for 24 months in case 1, and for 12 months in case 2: delayed recall of prose passages (logical memory component of the Wechsler Memory Scale WMS) has remained severely impaired as has the ability to learn word pairs on the paired associate learning (PALT) component of the WMS.12,14

On a modified version of the drilled word list learning test of Weintraub and Mesulam,6,15 using a standard eight word list, both patients required an abnormally large number of learning trials to reach the criterion of three consecutively correct trials [(eight and nine trials, respectively; controls 4-8 (1-2)]. In addition, they demonstrated a rapid rate of forgetting: at five minutes they retained 50% and at 15 minute only 25% of the word list (normal controls retain virtually 100% throughout). Recognition memory for verbal material appeared to be superior to free recall. On the Warrington Recognition Memory Test (WRMT),16 case 1 obtained raw word recognition scores at the 25th percentile level, whilst that of case 2 was just above the 10th percentile.

In contrast to their performance on tests of verbal memory, both patients showed improvement on some measures of nonverbal memory during the six to 12 months following surgery. On the supraspan block tapping test,17 initially both failed to reach the criterion of two correct runs after 20 trials. By six months (case 2) and 14 months (case 1) their performances

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**Table 1** Results of general intellectual and memory tests in case 1

<table>
<thead>
<tr>
<th>Test</th>
<th>Aug 85 (1 month)</th>
<th>Oct 85 (3 months)</th>
<th>Sept 86 (14 months)</th>
<th>Aug 87 (24 months)</th>
<th>Expected Range*</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ Verbal</td>
<td>89</td>
<td>94</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>112</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Scale</td>
<td>99</td>
<td>107</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NART</td>
<td>101</td>
<td>103</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digits Forward</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Backward</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Verbal Memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paragraph Immed</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Delayed (60 mins)</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PAL'T Immed</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Delayed Easy</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Warrington RMT'</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Words (raw score)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Items recalled</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Mean displacement</td>
<td>9</td>
<td>8</td>
<td>2</td>
<td>5</td>
<td>11</td>
</tr>
</tbody>
</table>

Key: 1 National Adult Reading Test, 2 Paired Associate Learning Test, 3 Warrington Recognition Memory Test, *based on age and IQ.

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**Table 2** Results of general intellectual and memory tests in case 2

<table>
<thead>
<tr>
<th>Test</th>
<th>July 87 (8 weeks)</th>
<th>Dec 87 (6 months)</th>
<th>August 88 (12 months)</th>
<th>Expected Range*</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ Verbal</td>
<td>112</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>114</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Scale</td>
<td>110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NART</td>
<td>110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digits Forward</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backward</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal Memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paragraph Immed</td>
<td>7</td>
<td>5</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Delayed (60 mins)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PAL'T Immed</td>
<td>5</td>
<td>6</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Delayed Easy</td>
<td>4</td>
<td>2</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Warrington RMT'</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Words (raw score)</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Mean displacement</td>
<td>9</td>
<td>8</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

Key: see Table 1.
were within the normal range, 8·2 (3·0). Their scores for delayed recall of the Rey-Osterrieth complex figure were initially in the severely impaired range, 6·0 and 7·5. By 12–24 months, however, case 1 had improved substantially whilst there was a less marked improvement in the score of case 2. It should be noted that a parallel form of the complex figure was used for alternate test sessions.

The pattern of results on the incidental spatial learning test of Smith and Milner revealed a dissociation between recall of item identity and recall of item location. In this test subjects are asked to name 16 toys randomly arranged on a 60 cm board and to estimate the price of the real item represented by the toy (for example, washing machine, watch). The toys are then removed from the board and after four minutes of distraction the subjects are asked to recall as many items as possible in one minute. They are then given the toys to replace on the board in their original positions. The number of items correctly recalled after four minutes was clearly impaired (four and two items respectively; controls 8·5 (1·8), whereas the mean item displacement was within normal limits, 9·1 and 7·4 cms; controls 7·9 (3·7) cms.

Further evidence for the selective improvement in case 2 comes from his performance on the WRMT. At eight weeks post-surgery, his face recognition score was seven points below that for word recognition; however, by six months the face recognition had improved by seven points without any substantial improvement in the word score.

Remote memory for public faces and events was assessed using a battery of tests previously described in detail. Since both patients were younger than those for whom the tests were developed, the famous faces and the famous events tests were adapted so that cases 1 and 2 were tested only for items from those decades since they reached adolescence (that is, case 1—late 1950s, 1960s, and 1970s; case 2—late 1960s and 1970s). For both patients naming of famous faces, recognition and dating of famous events was within the normal range for all decades tested. In addition, they were assessed on an ad hoc test of famous face naming, consisting of 35 additional photographs of people who had come to prominence in the 1970s (n = 17) and 1980s (n = 18), using their spouses as controls; in case 1 the overall score (91·4%) was superior to that of her husband (82·8%) and in case 2 (82·8%) was virtually identical to that of his wife (80%). It can be seen in table 3 that their performance was equally good for items from both decades.

Remote memory for personal events was assessed using the Modified Groovitz Test, in which subjects are asked to generate personal memories evoked by each of 10 nouns (for example, ship, flag, tree) and then to date the memories produced. Each episode is scored for temporal specificity and richness of detail according to the criteria previously described. The patients had no difficulty producing detailed and specific memories, scores case 1:30, case 2:29; normal subjects 28·3 (1·9). The age distribution of the episodes corresponded to that of normal subjects, who very consistently produce 25% of the memory from the most recent five years, 20 cases 1 and 2, produced 30% and 40% from this era. Thus the results of the formal tests of remote memory support the clinical impression that neither patient had evidence of a temporally extensive retrograde amnesia.

Discussion

The development of virtually identical neuropsychological deficits in two patients following the trans-calloso removal of a colloid cyst from the IIIrd ventricle is clearly of practical importance. It is well recognised that patients with colloid cysts in this site may present with a variety of behavioural abnormalities, including memory impairment. Although the two patients in this study did not have formal neuropsychological assessment pre-operatively, there was no clinical evidence of memory impairment, and both had continued to lead normal lives until the time of surgery. Whereas, it became immediately apparent following the removal of the cysts that they had developed a clinically significant amnesic syndrome. The conclusion that the memory deficit arose as a complication of the surgical procedure rather than from the colloid cyst itself appears unavoidable.

Furthermore, the diagnosis in both cases was made at a relatively early stage since neither had evidence of persistently raised intracranial pressure, nor marked ventricular enlargement. Colloid cysts of the IIIrd ventricle are notoriously difficult to diagnose since the symptoms are usually intermittent and can be extremely varied. The advent of CT scanning has revolutionised the ability to detect colloid cysts at an early stage, as shown in our cases. The developments in diagnostic techniques together with advances in neurosurgical technique, notably the use of the operating microscope, have also improved the prognosis. It is therefore important to note that despite these advances, the removal of lesions from the IIIrd ventricle is not without the risk of significant sequelae. The statement by Nitta and Symon that the excision of colloid cysts is now "a relatively straightforward procedure with

Table 3 Results of the additional neuropsychological tests of frontal executive function and language in cases 1 and 2

<table>
<thead>
<tr>
<th>Test</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ravens Advanced Progressive Matrices</td>
<td>8</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Trail Making Test A sec</td>
<td>19</td>
<td>26</td>
<td>25</td>
</tr>
<tr>
<td>B sec</td>
<td>45</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Verbal Fluency (Letters F, A, R)</td>
<td>45</td>
<td>35</td>
<td>45</td>
</tr>
<tr>
<td>Boston Naming Test (max = 60)</td>
<td>57</td>
<td>52</td>
<td>57</td>
</tr>
</tbody>
</table>

Table 4 Performance of cases and controls (spouses) on an ad hoc test of famous faces from the 1970s and 1980s

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970s</td>
<td>17</td>
<td>15</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>1980s</td>
<td>18</td>
<td>17</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>32 (91·4%)</td>
<td>29 (82·8%)</td>
<td>28·5 (81·4%)</td>
</tr>
</tbody>
</table>
Anterograde amnesia with fornix damage following removal of IIInd ventricle colloid cyst

minimal morbidity” should be modified in this light.

A full discussion of the surgical approaches to the IIInd ventricle is beyond the scope of this article and has been recently reviewed in detail.2 Briefly summarised, dorsal approaches are now generally favoured for the removal of colloid cysts, either transcortically or transcallosally. The classic trans cortical-transventricular approach to the foramen of Munro allows easy identification of the landmarks within the lateral ventricle, but is unsuitable for patients without hydrocephalus and carries the problems inherent in transecting the frontal cortex. The anterior transcallosal approach to the lateral ventricle, as used in our patients, allows good visualisation of both walls of the IIInd ventricle, is applicable in patients without hydrocephalus, but may carry greater risk of fornical damage.

This brings us to the controversy in the literature on the relationship of section of the fornix to memory loss. Sweet et al, in 1998,24 first drew attention to recent memory loss following bilateral fornix section. Similarly, Cameron and Archibald25 reported selective amnesia for verbal material after left fornix section, and Carmel1 included in a larger series two patients with persistent memory impairment in whom the right fornix was sectioned to achieve better exposure at the foramen of Munro. The series by Geffen et al26 also included a patient with a persistent amnesic syndrome following the transcallosal removal of a IIInd ventricular colloid cyst; this patient was the only one, of the four reported, to have had bilateral fornical section. Further evidence for the role of the fornix comes from the reports by Heilman and Sypert27 and by Tucker et al,28 of amnesic deficits resulting from the destruction of the posterior fornix by invasive tumours in this area, and from the report by Grafman et al29 of a patient with severe memory impairment resulting from a penetrating shrapnel wound that transected the columns of the fornix bilaterally.

On the other hand, a number of surgeons30-31 report sectioning the fornix without causing clinically overt memory problems. Neoplastic destruction of the fornices without memory impairment has also been described.32 This apparently contradictory and confusing literature was recently reviewed by Garcia-Bengochea and Friedman,33 who drew attention to the fact that in excess of 150 cases of stertotic anterior fornicectomy have been performed for the treatment of epilepsy without apparent memory loss. Although, as they also point out “the possibility cannot be ruled out that memory deficits have gone unnoticed in a number of epilepsy patients, particularly as most were also afflicted by psychiatric disturbances” which may well have precluded formal memory testing. None of the studies claiming a lack of effect of fornix section has included formal neuropsychological assessment.

It is well established that damage to the amygdala and hippocampus result in marked impairments in anterograde memory processes.34 Given that the fornix is a major efferent pathway connecting the hippocampus to the other limbic and diencephalic structures—which also play an essential role in human memory—it would be surprising if damage to the fornix did not cause memory impairment. In our patients, it seems most likely that one (or both) forntical columns sustained direct or indirect (for example, vascular) injury at the time of surgery. This conclusion is partly speculative since pathological confirmation of the site of damage is not available. In both patients, however, CT scans have demonstrated lesions corresponding to the left fornical column, and more recently obtained MRI images indicate severance of one or both fornices. Furthermore, in neither case has damage to other known memory-related structures (that is, the hippocampus, and parahippocampal region, or the anterior and dorsomedial thalamic nuclei) been demonstrated. Damage to these or other cerebral structures cannot be totally excluded by presently available in vivo methods. The discrepancy between Verbal and Performance scores in case 2 suggests that she may have sustained more left hemisphere damage in addition to the fornix injury.

For our neuropsychological findings, in both cases verbal and nonverbal anterograde memory were initially affected to a similar degree. Over the next three to six months, however, there was substantial improvement in some measures of nonverbal memory without a concomitant improvement in verbal memory. Although the effects of practice may have accounted for some of this increase, especially on recall of the Rey-Osterrieth figure, the considerably improved score in case 2 on the face recognition part of the WRMT and in both patients’ performance on the supraspical block tapping test cannot easily be explained on this basis. That unilateral damage to the right and left hippocampi selectively impair nonverbal and verbal memory processes is well established.34 Given the site of pathology, the interesting possibility arises that the left fornix carries pathways specialised for verbal memory from the hippocampus to the mammillary bodies. This conclusion is supported by two previous studies reviewed by Cameron and Archibald25 in which left fornix section resulted in a selective verbal memory deficit, and the report by Tucker et al,28 of a modality specific amnesia in a patient with destruction of the left fornix by an invasive tumour.

The other suggested but less definite dissociation in both patients is between anterograde and retrograde amnesia. Whereas both patients had a persistent and clinically significant anterograde deficit, neither showed a remote memory deficit of more than a few weeks duration either on detailed informal assessment. Furthermore formal tests of remote memory showed normal performance including an ad hoc test of famous faces from the 1970s and 1980s in which the patients’ spouses were used as controls. The nature of these tests is such that a very minor degree of retrograde amnesia may not be shown. There was, however, a clinically obvious discrepancy between these two memory components in both cases.
The relationship between these components in patients with the amnesic syndrome remains controversial. Bilateral hippocampal ablation results in a profound degree of anterograde amnesia without a temporarily extensive retrograde memory loss. By contrast, in diencephalic amnesia (as exemplified by Korsakoff's syndrome) there is typically a very extensive retrograde memory impairment extending over many decades. It has been suggested that the extent of retrograde amnesia is directly related to the site of pathology. It would be predicted that fornix damage, with resultant hippocampal deafferentation, would result in a temporally retrograde amnesia as was the case in the two patients. Recent evidence, however, casts doubt upon this simple anatomical relationship, since temporally extensive retrograde amnesia may be associated with hippocampal pathology and diencephalic amnesia is not invariably associated with an extensive retrograde loss. The absence of a substantial retrograde amnesia cannot easily be explained by the relative mildness of the anterograde deficit since recent studies suggest that there is no direct correlation between the severity of anterograde and retrograde amnesia.

On a practical level it is interesting that both patients had adapted well to their memory deficit. Several possible explanations are suggested; firstly, the amnesic disorder appears in both cases to be relatively pure with preservation of frontal executive function and of insight. This has enabled them to develop and apply successful mnemonic strategies. Secondly, the apparent sparing of remote memory means that they are able to draw on their pre-operative semantic and episodic memory to a degree which is unusual in amnesic subjects.

In conclusion, the two cases we report highlight the fact that persistent anterograde memory impairment may follow the apparently uncomplicated transectional removal of IIIr ventricle colloid cysts. More subtle deficits may be commoner than is at present appreciated and further studies are required to answer this question.

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24 Sweet WH, Talland GA, Ervin FR. Loss of recent memory following section of the fornix. Trans Am Neurol Assoc 1959;84:72-82.
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