

## Case Report

# Fornix Infarction Resulting in Persistent Global Amnesia: Two Cases and a Review of the Literature

Reena Baweja<sup>1</sup>, Arun Mensinkai<sup>2</sup>, Kesava Reddy<sup>1</sup>, Ayse Unsal<sup>3</sup> and Demetrios J. Sahlas<sup>4\*</sup>

<sup>1</sup>Division of Neurosurgery, Department of Surgery, McMaster University, Canada

<sup>2</sup>Department of Radiology, Hamilton General Hospital – Hamilton Health Sciences, Canada

<sup>3</sup>Department of Psychiatry and Behavioural Neurosciences, McMaster University, Canada

<sup>4</sup>Division of Neurology, Department of Medicine, McMaster University, Canada

**\*Corresponding author**

Demetrios J. Sahlas, Hamilton General Hospital, Room 706, McMaster Wing, 237 Barton Street East, Hamilton, Ontario, Canada, Tel: 905-527-4322 ext. 46373; Fax: 905-577-8036, Email: sahlas@mcmaster.ca

Submitted: 14 March 2016

Accepted: 09 April 2016

Published: 11 April 2016

**Copyright**

© 2016 Sahlas et al.

**OPEN ACCESS****Keywords**

- Amnesia
- Aneurysm
- Fornix
- Limbic system
- Stroke

**Abstract**

Bilateral fornix infarction presenting with combined retrograde and anterograde amnesia is a recognized, yet rare, clinical entity. We present details of two cases – the first was a spontaneous infarction attributed to small vessel cerebrovascular disease and the second was a post-operative complication following clipping of an anterior communicating artery aneurysm. Both infarcts were initially missed on non contrast CT although later confirmed on MRI. Comprehensive neuropsychological assessment was completed for both patients, including a two year follow-up assessment on our second patient, demonstrating minimal improvement. The anatomy related to the perforators of the anterior communicating artery is reviewed as well as the importance of considering fornix infarction on brain imaging in any patient presenting with acute global amnesia.

**ABBREVIATIONS**

Acomm: Anterior Communicating Artery; BVM-T-R Delayed: Brief Visual Memory Test – Revised Delayed Free Recall; CT: Computed Tomography; CVLT – II Del: California Verbal Learning Test – Second Edition Delayed Free Recall; LMII: Logical Memory II; MoCA: Montreal Cognitive Assessment; MRI: Magnetic Resonance Imaging; PRI: Perceptual Reasoning Index; PS: Processing Speed Index; Trails B: Trail Making Test B; VCI: Verbal Comprehension Index; WAIS-IV FSIQ: Wechsler Adult Intelligence Scale – 4th Edition Full Scale IQ; WCST per err: Wisconsin Card Sorting Test number of perseverative errors; WMI: Working Memory Index; WMS-IV LMII: Wechsler Memory Scale – 4th Edition Logical Memory II; %tile: Percentile associated with age-based norms

**INTRODUCTION**

The fornix is a discrete white matter bundle that arches to form a connection between the hippocampi in the medial temporal lobes and the mammillary bodies and anterior thalami. In doing so, it is involved in the formation and consolidation of memories through the classic circuit of Papez [1].

Infarction of the fornix resulting in anterograde amnesia

is rare, and can also include symptoms of perseveration, disinhibition and other cognitive abnormalities [2].

We report two cases of bilateral fornix infarction, one which occurred spontaneously presumably due to small vessel disease and one secondary to clipping of an anterior communicating artery (Acomm) aneurysm.

**CASE PRESENTATION****Case 1**

A 74 year-old woman presented to hospital with a five-day history of short-term memory loss and perseveration. The symptoms began the morning after she returned home from a trip to China. The patient repeatedly asked her husband whether the luggage from their trip had been unpacked and was convinced that items had been stolen from their luggage even though she was repeatedly told this was not the case. Her husband also stated that she could not remember details of any events since the morning of their return – for example, their granddaughter visited them although the patient couldn't remember her visit later that same day.

Past medical history was notable for hypertension, type 2 diabetes mellitus, hyperlipidemia, celiac disease, hypothyroidism,

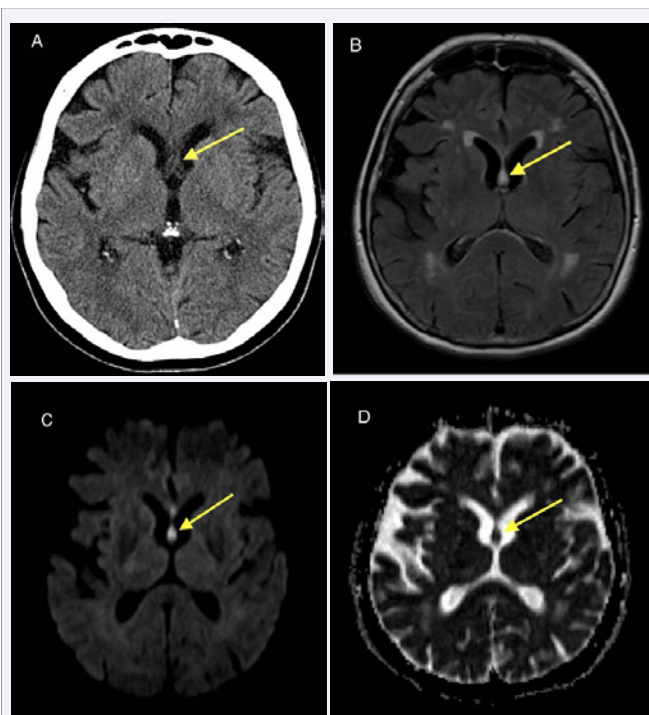
and breast cancer (treated with lumpectomy and radiation therapy). She was a nonsmoker who consumed minimal alcohol. Her medications included telmisartan, hydrochlorothiazide, metformin, pravastatin, nizatidine and levothyroxine. She was retired from a position in a university accounting office. On examination, she appeared comfortable but somewhat disinhibited. Her attention, working memory and immediate recall were impaired. Montreal Cognitive Assessment (MoCA) score was 19/30. Neurological exam was otherwise normal.

A non contrast CT scan of the head done in the emergency department showed mild leukoaraiosis in addition to a possible sub acute infarct involving the fornix (Figure 1a). An MRI with FLAIR and DWI sequences was ordered which confirmed bilateral fornix infarction in addition to chronic microangiopathic changes seen on the initial CT scan (Figure 1 b-d).

The patient was seen again in follow-up five months after the initial event. She had shown significant improvement by that time but still had residual cognitive deficits. Her MoCA score had improved to 22/30. She was started on clopidogrel due to intolerance to aspirin and a neuropsychological assessment was arranged. Comprehensive evaluation conducted nine months after the onset of forgetfulness showed low average performance on tests of general intelligence and verbal comprehension, with impairments in working memory, and 2 of 3 delayed recall memory measures (Table 1). All other measures were essentially normal.

## Case 2

A 56 year-old woman was referred to our endovascular clinic



**Figure 1** (A) Axial CT scan of the head depicts hypo attenuation of the fornix (arrow). (B) Axial MRI FLAIR of the brain demonstrates hyper intensity of the fornix associated with restricted diffusion on (C) Axial DWI and corresponding (D) ADC map.

**Table 1:**

	Case 1 (%tile)	Case 2 (%tile)	Case 2 (%tile) repeat
WAIS-IV FSIQ	21	66	NA
VCI	25	63	75
PRI	34	55	NA
WMI	8	55	NA
PSI	50	73	NA
CVLT - II Del	30	<1	<1
WMS-IV LMII	5	<1	9
BVMT-R Del	7	<1	7
Trails B	39	81	NA
WCST per err	>50	55	NA

**Abbreviations:** WAIS-IV FSIQ: Wechsler Adult Intelligence Scale – 4th Edition Full Scale IQ; VCI: Verbal Comprehension Index; PRI: Perceptual Reasoning Index; WMI: Working Memory Index; PS: Processing Speed Index; CVLT – II Del: California Verbal Learning Test – Second Edition Delayed Free Recall; WMS-IV LMII: Wechsler Memory Scale – 4th Edition Logical Memory II; BVMT-R Delayed: Brief Visual Memory Test – Revised Delayed Free Recall; Trails B: Trail Making Test B; WCST per err: Wisconsin Card Sorting Test number of perseverative errors; %tile: Percentile associated with age-based norms

for assessment of an Acomm aneurysm discovered incidentally on MRI performed to investigate her headaches. Past medical history was only notable for treated depression. She was an ex-smoker with a 30 pack-year history, and consumed 5 glasses of wine per week. Her medications included fluoxetine, zopiclone and a nicotine patch. Family history included a father who died secondary to rupture of a cerebral aneurysm. She lived with her husband and was retired from a steel manufacturing company. Her neurological examination was unremarkable.

The anatomy of the patient's aneurysm was deemed unsuitable for a coiling procedure. She was therefore referred to neurosurgery for a right pterional craniotomy and clipping. She developed confusion following surgery which failed to resolve by post-operative day 4. Her orientation and attention were normal. Working memory was also intact although recent memory was impaired. This was demonstrated by repeatedly asking questions about deceased relatives and pets. She also asked questions regarding her hospital stay, which would promptly be answered, after which she would immediately repeat the same questions. Lab investigations were only notable for a Na<sup>+</sup> of 122 and both CT and MRI showed bilateral fornix infarction.

On one month follow-up with neurology, the patient's short term memory issues had improved significantly. At that point, she also became aware of anosmia. Comprehensive neuropsychological assessment was conducted three months after the surgery, and revealed normal neurocognitive function, including working memory, with the exception of impaired learning and delayed free recall for both verbal and visual stimuli (performances at less than the 1st percentile). Arrangements were made for an assessment by occupational therapy in order for the patient to resume as many activities of daily living as possible. Follow up neuropsychological evaluation at two years' post surgery showed a statistically significant

improvement in both the WMS-IV LMII and BMVT-R. However, the level of performance would be considered impaired from a clinical standpoint, especially in comparison to otherwise high performances in other areas.

## DISCUSSION

Our first case involved spontaneous, acute-onset amnesia resulting from bilateral fornix infarction. The patient had risk factors for stroke along with chronic microangiopathic changes demonstrated on CT. Her infarct was attributed to small vessel disease involving the perforating vessels of the anterior communicating artery or alternately the short medial central arteries, branches of the anterior cerebral artery that exclusively supply the fornix [2-4].

Anterior cerebral artery infarcts are rare (3% of all acute ischemic infarcts) and infarction of the perforators of either the anterior cerebral artery or anterior communicating artery even rarer [4]. Despite this, the possibility of a fornix infarction should always be part of the differential diagnosis of spontaneous, acute onset global amnesia. Case reports in the literature have described patients being misdiagnosed with Alzheimer's disease [5] or an acute psychiatric disorder [6] with a presentation of acute-onset amnesia. A subset of cases of transient global amnesia also involve cerebral ischemia underscoring the importance of keeping fornix infarction as part of the differential diagnosis when considering patients who present with classic symptoms of transient global amnesia [7].

In our second case, the findings of anterograde amnesia can be attributed to a specific lesion – the bilateral fornix infarction described above. We postulate that this infarction resulted from ischemia of one of the dorsal perforators arising from the posterior aspect of the anterior communicating artery. The association between surgical treatment of anterior communicating artery aneurysms and an amnesic syndrome, which may be accompanied by confusion and cognitive behavioral changes, was first noticed by two Swedish neurosurgeons in 1953 [8]. These findings are usually attributed to damage of the pre-commissural area as well as the septo-hippocampal pathways during dissection of said aneurysm rather than a discrete lesion per se [9]. The three groups of perforators include the chiasmatic, hypothalamic and subcallosal arteries [10]. They are particularly difficult to appreciate during surgery due to their dorsal course [8]. The subcallosal artery, a 0.5mm terminal artery, is particularly vulnerable to ischemia given its unpaired nature [10]. We postulate that retraction on these perforator arteries, specifically the subcallosal artery, during dissection to clip this aneurysm likely resulted in the infarction described above.

There are six cases of fornix infarction described in the literature that are attributed to anterior communicating artery (AComm) aneurysms [2,10,11], either from surgical manipulation or hemorrhage. Surgical manipulation of the AComm artery can cause ischemia of any of the perforators arising from the posterior aspect of the artery. The subcallosal artery, a 0.5 mm terminal artery, is the most vulnerable of these perforators and ischemia of this artery can cause a Korsakoff-like dementia characterized by acute confusion, severe anterograde amnesia and cognitive-behavioral changes [10].

The main symptoms of the 'ACoA syndrome' are severe amnesia, personality changes and confabulation [12]. Interestingly, our patient did not exhibit confabulation and this could be due to the integrity of the other components of the limbic system including the mammillary bodies and corpus callosum. Given the difficulty of visualizing the perforators from the dorsal aspect of the AComm, in addition to the anterior and inferior projection of the dome of this aneurysm – it would have been very difficult to prevent this complication due to need of adequate visualization of the aneurysm through dissection in the area of the perforators.

Interestingly, performance on the CVLT – II Del was relatively preserved in our first patient, but severely impaired along with both the WMS-IV LMII and BMVT-R in our second patient. Conversely, working memory remained impaired at nine months after her stroke in our first patient, but was essentially normal at three months in our second patient. These are different measures of memory, and likely illustrate differential sensitivities to limbic/hippocampal integrity.

We present two patients with acute onset persistent global amnesia, the first occurring spontaneously as a lacunar syndrome secondary to small vessel disease, and the second caused by clipping of an AComm aneurysm. Both patients had non contrast CTs wherein the lesions were not initially well appreciated, although were subsequently confirmed on MRI. Comprehensive neuropsychological evaluation revealed long-term deficits. We propose that MRI versus CT in addition to a detailed clinical history may be more valuable in making this diagnosis.

## ACKNOWLEDGMENTS

Dr. Sahlas is supported by the MG De Groote Professorship in Stroke Management, McMaster University.

## REFERENCES

1. Thomas AG, Koumellis P, Dineen RA. The fornix in health and disease: an imaging review. *Radiographics*. 2011; 31: 1107-1121.
2. Meila D, Saliou G, Krings T. Subcallosal artery stroke: infarction of the fornix and the genu of the corpus callosum. The importance of the anterior communicating artery complex. Case series and review of the literature. *Neuroradiology*. 2015; 57: 41-47.
3. Adamovich BL, Gualberto G, Roberts T, Haut MW, Gutmann L. Teaching Neurolmages: amnesia due to fornix infarction. *Neurology*. 2009; 73: 86.
4. Moudgil SS, Azzouz M, Al-Azzaz A, Haut M, Gutmann L. Amnesia due to fornix infarction. *Stroke*. 2000; 31: 1418-1419.
5. Korematsu K, Hori T, Morioka M, Kuratsu J. Memory impairment due to a small unilateral infarction of the fornix. *Clin Neurol Neurosurg*. 2010; 112: 164-166.
6. Saito Y, Matsumura K, Shimizu T. Anterograde amnesia associated with infarction of the anterior fornix and genu of the corpus callosum. *J Stroke Cerebrovasc Dis*. 2006; 15: 176-177.
7. Arena JE, Rabinstein AA. Transient global amnesia. *Mayo Clin Proc*. 2015; 90: 264-272.
8. Gade A. Amnesia after operations on aneurysms of the anterior communicating artery. *Surg Neurol*. 1982; 18: 46-49.
9. Anatomical Pathways Related to the Clinical Findings in Aneurysms of

- the Anterior Communicating Artery. *J Neurol Neurosurg Psychiatry*. 1965; 28: 228-234.
10. Mosiman PJ, Saint-Maurice JP, Lenck S, Puccinelli F, Houdart E. Fornix infarction and Korsakoff dementia after coiling of a large anterior communicating artery aneurysm. *Neurol Clin Pract*. 2012; 2: 260-262.
11. Hattingen E, Rathert J, Raabe A, Anjorin A, Lanfermann H, Weidauer S. Diffusion tensor tracking of fornix infarction. *J Neurol Neurosurg Psychiatry*. 2007; 78: 655-656.
12. Bottger S, Prosiegel M, Steiger HJ, Yassouridis A. Neurobehavioral disturbances, rehabilitation outcome, and lesion site in patients after rupture and repair of anterior communicating artery aneurysm. *J Neurol Neurosurg Psychiatr*. 1998; 65: 93-102.
13. Mugikura S, Kikuchi H, Fujii T, Murata T, Takase K, Mori E, et al. MR imaging of subcallosal artery infarct causing amnesia after surgery for anterior communicating artery aneurysm. *AJNR Am J Neuroradiol*. 2014; 35: 2293-2301.
14. Park SA, Hahn JH, Kim JI, Na DL, Huh K. Memory deficits after bilateral anterior fornix infarction. *Neurology*. 2000; 54: 1379-1382.
15. Rizek P, Pasternak S, Leung A, Jenkins ME. Acute-onset anterograde amnesia caused by isolated bilateral fornix infarction. *Can J Neurol Sci*. 2013; 40: 738-739.

#### Cite this article

Baweja R, Mensinkai A, Reddy K, Unsal A, Sahlas DJ (2016) Fornix Infarction Resulting in Persistent Global Amnesia: Two Cases and a Review of the Literature. *J Neurol Disord Stroke* 4(1): 1110.