CASE REPORT

Posterior spinal artery aneurysm rupture after 'Ecstasy' abuse

Jeremiah Johnson,¹ Shnehal Patel,² Efrat Saraf-Lavi,³ Mohammad Ali Aziz-Sultan,⁴ Dileep R Yavagal⁵

¹Department of Neurosurgery, University of Miami Miller School of Medicine, Miami, Florida, USA

²Department of Neurology, University of Miami Miller School of Medicine, Miami, Florida, USA

³Department of Radiology, University of Miami Miller School of Medicine, Miami, Florida, USA

⁴Department of Neurosurgery, Harvard Medical School/Brigham and Women's Hospital, Boston, Massachusetts, USA

⁵Department of Neurology and Neurosurgery, University of Miami, Miami, Florida, USA

Correspondence to

Dr Dileep R Yavagal, dyavagal@med.miami.edu

Accepted 2 May 2014

SUMMARY

Posterior spinal artery (PSA) aneurysms are a rare cause of subarachnoid hemorrhage (SAH). The commonly abused street drug 3,4-methylenedioxymethamphetamine (MDMA) or 'Ecstasy' has been linked to both systemic and neurological complications. A teenager presented with neck stiffness, headaches and nausea after ingesting 'Ecstasy'. A brain CT was negative for SAH but a CT angiogram suggested cerebral vasculitis. A lumbar puncture showed SAH but a cerebral angiogram was negative. After a spinal MR angiogram identified abnormalities on the dorsal surface of the cervical spinal cord, a spinal angiogram demonstrated a left PSA 2 mm fusiform aneurysm. The patient underwent surgery and the aneurysmal portion of the PSA was excised without postoperative neurological sequelae. 'Ecstasy' can lead to neurovascular inflammation, intracranial hemorrhage, SAH and potentially even de novo aneurysm formation and subsequent rupture. PSA aneurysms may be treated by endovascular proximal vessel occlusion or open surgical excision.

BACKGROUND

In the absence of spinal vascular malformations, spinal arterial aneurysms are uncommon lesions and posterior spinal artery (PSA) aneurysms are particularly rare. The street drug 3,4-methylenedioxymethamphetamine (MDMA) or 'Ecstasy' is an amphetamine derivative that, when ingested, leads to serotonin release, acute sympathetic surge and can result in intracranial hemorrhage. In this report we describe a teenager who experienced subarachnoid hemorrhage (SAH) after MDMA use and was found to have a cervical PSA aneurysm. To our knowledge, this represents the 13th PSA aneurysm reported in the literature, the first PSA aneurysm with an identified underlying cause and the first aneurysm of any spinal vessel linked to drug abuse.

CASE PRESENTATION

Eight days prior to seeking medical attention, a previously healthy teenager took MDMA or 'Ecstasy' and awoke the next morning with headache, neck pain and muscle spasms. After 1 week of persistent symptoms, the patient experienced a sudden increase in headache severity, neck pain and nausea and sought medical attention. In the emergency department of an outside hospital, an initial plain brain CT was negative but a cerebral CT angiogram (CTA) showed beading of the cerebral arteries and vasculitis was suspected. Given his later discovered

SAH, vasospasm could also be on the differential diagnosis for these findings on CTA (figure 1A).

Thirteen days after the original headache the patient was transferred to our institution and underwent a lumbar puncture: Tube 1: 155 white blood cells, 2200 red blood cells; Tube 4: 196 white blood cells, 650 red blood cells, glucose 17, protein 122, plus xanthochromia. A six-vessel cervical and cerebral angiogram did not show evidence of cerebral vasculitis, vasospasm or vascular abnormalities. However, an MRI/MRA of the cervical spine showed an enhancing nodular area along the left dorsal surface of the cord at C5–C6 suggestive of a spinal vascular lesion and a second area of linear enhancement extending laterally along the course of the right dorsal T1–T2 nerve root (figure 1B, C). An investigation for underlying infectious, inflammatory and connective tissue disorders was negative.

The patient underwent a cervical and thoracic spinal angiogram, and the left deep cervical artery injection revealed a 2.2 mm×1 mm fusiform aneurysmal dilation of the left PSA at the level of C5–C6 (figure 1D–F). The PSA harboring the aneurysm filled via a network of small anastomotic channels, so safe effective endovascular embolization was not possible. The second suspicious enhancing area at T1–T2 was not seen angiographically.

TREATMENT

A C5–C6 laminectomy and intradural exploration was performed. Upon dural opening, the fusiform aneurysm of the left PSA was clearly visible on the dorsal surface of the spinal cord (figure 1G). After isolating the diseased portion of the vessel, the PSA aneurysm was excised.

OUTCOME AND FOLLOW-UP

Following surgery the patient was neurologically intact including normal vibratory sensation and proprioception. He remained asymptomatic at 3 months.

DISCUSSION

The compound MDMA or 'Ecstasy,' an amphetamine derivative, is a commonly used recreational drug; however, similar to other sympathomimetic drugs, its use has been associated with a number of severe systemic and neurological complications.¹ Intracranial complications including SAH, cerebral vasculitis and intraparenchymal hemorrhages have been reported after MDMA use.² MDMA consumption can lead to a sympathetic surge resulting

CrossMark

To cite: Johnson J, Patel S, Saraf-Lavi E, et al. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2014-011248

Figure 1 (A) Coronal reconstruction image of a cerebral CT angiogram showing an irregular contour of the supraclinoid internal carotid artery, proximal anterior cerebral artery and middle cerebral artery branches. (B, C) Right parasagittal MIP image of a 3D time-of-flight contrast-enhanced MR angiogram of the cervical spine showing nodular focal enhancement in the posterolateral aspect of the spinal cord at C5–6 (B) and T1–2 (C) levels. (D) Anteroposterior projection of a digital subtraction angiography following injection of the left deep cervical artery showing a distal anastomosis filling the radiculopial artery and posterior spinal artery (PSA). A 2 mm fusiform aneurysmal dilation of the left PSA is noted (arrow). (E) Coronal and (F) sagittal reconstructed images from a dynamic CT angiogram performed via a selective arterial injection during the angiography showing the PSA aneurysmal dilation at C5–6. (G) Magnified intraoperative image of the dorsal spinal cord (orientation: left is rostral and right is caudal) with the PSA aneurysmal dilation trapped between two forceps (bronze color). The aneurysm was subsequently ligated and excised.

in elevated blood pressure, and potentially may cause the pre-existing vascular lesions such as aneurysms and arteriovenous malformations to rupture.³ However, some authors have implicated MDMA in de novo aneurysm formation.⁴ The events by which MDMA is believed to affect the cerebral vasculature includes post-ingestion serotonin surge-induced microvascular changes combined with acute post-consumption blood pressure elevation resulting in hemorrhage.^{3, 4} In the current report, the patient had early beading of the cerebral vessels indicating widespread cerebrovascular inflammation. The authors theorize that the serotonergic and sympathomimetic properties of MDMA led to post-MDMA consumption systemic hypertension, intimal injury, spinal aneurysm formation, vascular inflammation and finally rupture. Although this mechanism of aneurysm formation and rupture seems most likely, a feasible alternative explanation is that the PSA aneurysm had already formed idiopathically prior to the drug abuse and that the systemic hypertension associated with MDMA ingestion led to the rupture.

Spinal SAH is uncommon and accounts for less than 1% of SAH. Spinal aneurysms are rare and are often found on spinal arteries with abnormally high flow. In contrast to their intracranial counterparts, spinal aneurysms form as focal or fusiform dilations of the vessel wall rather than at branch points and they lack an internal elastic lamina vessel layer, suggesting that they

result from an intimal dissection.⁵ High flow states that can lead to spinal artery aneurysm formation include spinal arteriovenous malformations, coarctation of the aorta, occipito-cervical dural arteriovenous fistula, vascular occlusions with spinal arteries providing collateral flow and other rare causes.^{6, 7} Intradural spinal aneurysms have been reported to originate from four spinal arteries: radiculomedullary, anterior spinal, posterior spinal and lateral medullary.⁷ Spontaneous PSA aneurysms are rare with only 12 cases having previously been reported (table 1). Prior to the current report, all 12 PSA aneurysms presented with SAH and were considered dissecting aneurysms of idiopathic etiology.

PSA aneurysms have been successfully treated by conservative management, open surgical resection and endovascular embolization. Conservative management may be appropriate when there are numerous spinal aneurysms or when intervention is likely to worsen the patient's neurological function⁸; however, it carries a risk of rebleeding.⁹ Endovascular embolization has been used to treat spinal aneurysms but, in PSA aneurysms, access to the lesion is typically via small arterial branches and all reported cases of PSA embolization have been proximal feeder occlusion without definitive aneurysm obliteration.^{7, 10} The aneurysm described in this report was not accessible to endovascular treatment due to the complex network of small vessels

Table 1 Posterior spinal artery aneurysms

Author, year	Age/sex	Level	Presentation	Underlying cause	Treatment	Outcome
Current report	Teenage/ –	C6	Headache, malaise, spinal SAH	NDMA consumption, dissection	Resection	Complete recovery
Shankar <i>et al</i> , 2012 ¹¹	72/F	L2	Back pain, spinal SAH	Idiopathic, dissection	Intercostal artery embolization	Complete recovery
Sato <i>et al</i> , 2012 ¹²	67/F	T8	Back pain, paraparesis, spinal SAH	Idiopathic, ASA and PSA dissections	Conservative	Partial recovery, regained ability to walk
Kim and Choi, 2012 ⁷	52/M	T7	Back pain, mild leg weakness, spinal SAH	Idiopathic, dissection	Intercostal artery embolization	Complete recovery
Tanweer <i>et al</i> , 2012 ¹⁰	67/F	T10	Paraplegia, spinal and intracranial SAH	Idiopathic, dissection	Embolization of proximal radiculopial	Improved sensory; no motor recovery
Geibprasert <i>et al</i> , 2010 ⁵	43/M	T4	Spinal SAH	Idiopathic, dissection	Clipping	Complete recovery
Cavuşoğlu <i>et al</i> , 2010 ¹³	27/F	C1	Intracranial SAH	Idiopathic, dissection	Clipping	Complete recovery
Nemecek <i>et al</i> , 2006 ¹⁴	54/M	T12	Paraplegia, spinal IMH and SDH	Idiopathic, dissection	Resection	Improved sensory; no motor recovery
Kocak <i>et al</i> , 2006 ⁹	54/F	C2	Severe headache, intracranial SAH	Idiopathic, dissection	None (rebled before treatment)	Death
Berlis <i>et al</i> , 2005 ⁸	62/F	T5	Back pain, mild weakness, spinal SAH	Idiopathic, dissection	Laminectomy, no resection due to thrombosis	Complete recovery
Handa <i>et al</i> , 1992 ¹⁵	3/F	C2	IMH, quadriplegia	Idiopathic, dissection	Resection	Complete recovery
Goto <i>et al</i> , 1988 ¹⁶	53/M	C2	Headache, stupor, intracranial SAH	Idiopathic, dissection	Resection	Complete recovery
Henson and Croft, 1956 ¹	51/M	C1	SAH	Idiopathic, dissection	None	Death

ASA, anterior spinal artery; C, cervical; IMH, intramedullary hemorrhage; L, lumbar; PSA, posterior spinal artery; NDMA, 3,4-methylenedioxymethamphetamine; SAH, subarachnoid hemorrhage; SDH, subdural hematoma; T, thoracic.

feeding the radiculopial artery and the PSA. Thus, our patient was treated with direct surgical excision of the aneurysm. Open surgical treatment of PSA aneurysms has the advantage of immediate obliteration of the lesion and avoids the use of liquid embolic material in the highly anastomotic spinal arteries. Of the six surgically treated PSA aneurysms in the literature, no new neurological deficits were reported after treatment.

Learning points

- Spinal subarachnoid hemorrhage (SAH) is uncommon but should be considered in the differential diagnosis of patients with sudden onset of severe back or neck pain.
- Spinal artery aneurysms are rare but should be considered in the differential diagnosis of spinal SAH.
- The street drug 3,4-methylenedioxymethamphetamine (MDMA) or 'Ecstasy' can lead to neurovascular inflammation, intracranial hemorrhage, SAH and even de novo aneurysm formation and subsequent rupture.
- When posterior spinal artery aneurysms are identified in stable patients, these lesions can be safely treated with surgical obliteration or, with favorable anatomy, endovascular parent vessel occlusion.

Contributors JJ and SP contributed to the conception, report design, data and image gathering, drafting of the manuscript, revising the manuscript and approval of the final manuscript. ES-L and MAA-S contributed to the conception, report design, manuscript revision and approval of the final manuscript. DRY contributed to the conception, report design, data and image gathering, supervised the revision of the manuscript and approved the final manuscript.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- 1 Henry JA, Jeffreys KJ, Dawling S. Toxicity and deaths from 3,4-methylenedioxymethamphetamine ('Ecstasy'). *Lancet* 1992;340:384–7.
- 2 Kahn DE, Ferraro N, Benveniste RJ. Three cases of primary intracranial hemorrhage associated with 'Molly', a purified form of 3,4-methylenedioxymethamphetamine (MDMA). *J Neurol Sci* 2012;323:257–60.
- 3 Selmi F, Davies KG, Sharma RR, *et al*. Intracerebral haemorrhage due to amphetamine abuse: report of two cases with underlying arteriovenous malformations. *Br J Neurosurg* 1995;9:93–6.
- 4 Auer J, Berent R, Weber T, *et al*. Subarachnoid haemorrhage with 'Ecstasy' abuse in a young adult. *Neurol Sci* 2002;23:199–201.
- 5 Geibprasert S, Krings T, Apitzsch J, *et al*. Subarachnoid hemorrhage following posterior spinal artery aneurysm. A case report and review of the literature. *Interv Neuroradiol* 2010;16:183–90.
- 6 Biondi A, Merland JJ, Hodes JE, *et al*. Aneurysms of spinal arteries associated with intramedullary arteriovenous malformations. II. Results of AVM endovascular treatment and hemodynamic considerations. *AJNR Am J Neuroradiol* 1992;13:923–31.
- 7 Kim HJ, Choi IS. Dissecting aneurysm of the posterior spinal artery: case report and review of the literature. *Neurosurgery* 2012;71:E749–56.
- 8 Berlis A, Scheufler KM, Schmahl C, *et al*. Solitary spinal artery aneurysms as a rare source of spinal subarachnoid hemorrhage: potential etiology and treatment strategy. *AJNR Am J Neuroradiol* 2005;26:405–10.
- 9 Kocak A, Ates O, Cayli SR, *et al*. Isolated posterior spinal artery aneurysm. *Br J Neurosurg* 2006;20:241–4.
- 10 Tanweer O, Woldenberg R, Zwany S, *et al*. Endovascular obliteration of a ruptured posterior spinal artery pseudoaneurysm. *J Neurosurg Spine* 2012;17:334–6.
- 11 Shankar JJ, terBrugge K, Krings T. Subarachnoid hemorrhage following posterior spinal artery aneurysm rupture. *Can J Neurol Sci* 2012;39:531–2.
- 12 Sato K, Roccatagliata L, Depuydt S, *et al*. Multiple aneurysms of thoracic spinal cord arteries presenting with spinal infarction and subarachnoid hemorrhage: case report and literature review. *Neurosurgery* 2012;71:E1053–8; discussion E1058.
- 13 Cavuşoğlu H, Özdemir A, Sahin Y, *et al*. Isolated posterior spinal artery aneurysm causing intracranial acute subarachnoid hemorrhage. *Acta Neurochir (Wien)* 2010;152:721–4.
- 14 Nemecek AN, Sviri G, Hevner R, *et al*. Dissecting aneurysm of the thoracic posterior spinal artery. Case illustration. *J Neurosurg Spine* 2006;5:555.
- 15 Handa T, Suzuki Y, Saito K, *et al*. Isolated intramedullary spinal artery aneurysm presenting with quadriplegia. Case report. *J Neurosurg* 1992;77:148–50.
- 16 Goto Y, Kamijyo Y, Yonekawa Y, *et al*. Ruptured aneurysm of the posterior spinal artery of the upper cervical spinal cord: case report. *Neurosurgery* 1988;22:558–60.

Copyright 2014 BMJ Publishing Group. All rights reserved. For permission to reuse any of this content visit <http://group.bmj.com/group/rights-licensing/permissions>.
BMJ Case Report Fellows may re-use this article for personal use and teaching without any further permission.

Become a Fellow of BMJ Case Reports today and you can:

- ▶ Submit as many cases as you like
- ▶ Enjoy fast sympathetic peer review and rapid publication of accepted articles
- ▶ Access all the published articles
- ▶ Re-use any of the published material for personal use and teaching without further permission

For information on Institutional Fellowships contact consortiasales@bmjgroup.com

Visit casereports.bmj.com for more articles like this and to become a Fellow