Spinal dural arteriovenous fistulae: a single centre experience

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Purpose

Spinal dural arteriovenous fistulae (sDAVF) are a rare vascular pathology that can be difficult to diagnose and is potentially devastating if treatment is delayed [1, 2]. Clinical presentation varies from leg dysesthesias to paraplegia and double sphincter dysfunction; therefore, a high index of suspicion with early radiological input is crucial [1, 2, 3, 4]. On T2-weighted MRI, multi-segmental spinal cord hyperintensity with associated subarachnoid flow voids is almost pathognomonic of the condition, however, sDAVF is commonly missed or misdiagnosed [4, 5]. While MR angiography may be useful, spinal digital subtraction angiography (DSA) remains the gold standard for diagnosis and treatment planning [4, 5]. As early treatment leads to improved patient outcomes, it is important to minimise delay to diagnosis [2].

Management options include endovascular embolisation and surgical disconnection [6]. A recent meta-analysis suggested that surgery is superior to embolisation for initial fistula occlusion and had lower recurrence rates, however, the authors note that the overall data quality was poor [6]. A 2017 case series suggested that newer embolic techniques may improve endovascular treatment outcomes to match those of surgery, however, their sample was too small to draw any significant conclusions [7]. Our study aims to investigate our institution's diagnostic process and contribute to the expanding literature comparing embolisation with surgical management of sDAVF.
**Fig. 1:** Schematic diagram of a sDAVF demonstrating a feeding radiculomeningeal artery entering a radicular vein. This leads to venous congestion, reduced drainage of normal spinal veins and distal cord oedema.

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**Fig. 2:** Intraoperative photograph of a spinal dural arteriovenous fistula (black arrow) and engorged perimedullary vessels (white arrow).

Fig. 3: 81 year old male with five weeks of progressive bilateral lower limb weakness escalating to acute urinary retention. a: Sagittal T2WI lumbar spine demonstrating oedema of the spinal cord at the conus medullaris. b: Sagittal T2WI thoracic spine demonstrating oedema and abnormal serpiginous vessels on the dorsum of the spinal cord. c: Axial T2WI lumbar spine demonstrating oedema of the conus medullaris and a central venous infarct. d: Frontal digital subtraction angiography of the right L1 segmental lumbar artery demonstrating the fistulous connection, draining vein and epidural connection as labelled. e: Sagittal T1WI with gadolinium contrast of a different patient, demonstrating contrast enhancement within the spinal cord consistent with oedema, not to be confused with an intramedullary tumour.

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Methods and materials

A retrospective, single-centre case series was conducted on patients with sDAVF that underwent treatment at our institution between January 2013 and May 2018. Diagnostic imaging, mode of treatment and treatment outcomes were evaluated.
Results

Twelve patients with sDAVF were included in our study, 4 females and 8 males, with an average age of 65. In diagnostic work-up, the average time from initial MRI to definitive diagnosis with DSA was 59 days. Where sDAVF was a provisional diagnosis on initial MRI, the average time to DSA was 31 days. Primary treatment and radiological outcomes at one year are outlined in table 1. The single recurrence in the surgical treatment group proceeded to embolisation, with no further recurrence. The single recurrence in the embolic treatment group proceeded to surgery, with no further recurrence. At the time of data collection, patients had undergone post-procedural follow-up imaging for an average of 478 days.
Table 1: Radiological outcomes at one year post treatment.

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<tr>
<th>Management</th>
<th>Pts</th>
<th>Outcomes at 1 year</th>
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<tbody>
<tr>
<td>Endovascular</td>
<td>6</td>
<td>5/6 no recurrence</td>
</tr>
<tr>
<td>Surgical</td>
<td>6</td>
<td>5/6 no recurrence</td>
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Fig. 4: 81 year old male with a spinal dural arteriovenous fistula. a: DSA demonstrating the anterior spinal artery (of Adamkiewicz) arising from the left L2 segmental lumbar artery. b: Unsubtracted DSA of the right L1 segmental lumbar artery post coil deployment. Both coils were utilised to restrict potential outflow paths prior to glue embolization. c: Glue in fistula and draining vein. d: DSA post embolization demonstrating no flow through the fistula.

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Fig. 5: 81 year old male two months post embolization of a spinal dural arteriovenous fistula. a: Sagittal T2WI lumbar spine demonstrating persistent but reduced conus medullaris oedema. b: Sagittal T2WI thoracic spine demonstrating resolution of oedema and serpiginous vessels. c: Axial T2WI lumbar spine demonstrating persistent but reduced conus medullaris oedema and small venous infarct.

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Conclusion

While our sample size is small, this case series suggests that the outcomes of primary endovascular and surgical treatment of sDAVF at our institution are similar. It also demonstrates that early consideration of sDAVF as a diagnosis on MRI may lead to earlier definitive diagnosis with angiography and subsequent treatment. More research is needed to minimise diagnostic delays and to define optimal treatment methods.
Personal information

Dr Thomas Pearson is a junior doctor working at the Sunshine Coast University Hospital, Queensland. He has a particular interest in interventional radiology, both general and neurointerventional.
References