Bow hunter’s syndrome: the use of dynamic magnetic resonance angiography and intraoperative fluorescent angiography

Case report

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Bow hunter’s syndrome is a diagnosis typically made using dynamic digital subtraction angiography. The authors present the case of a 68-year-old woman who presented with symptoms consistent with bow hunter’s syndrome that was accurately diagnosed utilizing noninvasive dynamic MR angiography. The dynamic MR angiogram clearly illustrated unilateral vertebral artery compression upon turning of the head. A subsequent CT of the cervical spine showed a ventral C-1 osteophyte within the foramen. The patient underwent posterior surgical decompression of the left vertebral artery. Sufficient decompression was confirmed using intraoperative fluorescent angiography with the patient’s head turned. This case report is the first to illustrate that dynamic MR angiography can be a reliable and less invasive diagnostic tool. It can also be used to confirm sufficient postoperative decompression and monitor for recurrence. Intraoperative fluorescent angiography has been previously used in the evaluation of intracranial and extracranial vascular patency. This report is the first to show that fluorescent angiography can offer rapid and reliable intraoperative evaluation of vertebral artery decompression in bow hunter’s syndrome.

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KEYWORDS • bow hunter’s syndrome • vertebral artery compression • dynamic magnetic resonance imaging • fluorescent angiography • indocyanine green angiography

Bow hunter’s syndrome is a unique clinical entity resulting from mechanical compression of the vertebral artery during motion of the neck. This is a diagnosis typically made using dynamic digital subtraction angiography. We describe the first case of bow hunter’s syndrome diagnosed using dynamic MR angiography and the first description of intraoperative dynamic indocyanine green (ICG) angiography (fluorescent angiography) to confirm satisfactory surgical treatment.

Case Report

History, Physical Examination, and Diagnostic Work-up. This patient was a 68-year-old woman who presented with complaints of episodes of disorientation, loss of balance, and occasional loss of consciousness. She first noticed these symptoms when turning her head to the right while driving. Her symptoms persisted for years, always induced by head rotation to the right. These symptoms became more frequent, at which point she sought medical attention. She had no significant past medical or surgical history. Her social history was noncontributory. Her neurological examination was unremarkable with no neurological deficits. Magnetic resonance imaging and MR angiography of the brain and cervical spine showed no pathology. There was normal filling of the bilateral carotid arteries and vertebral arteries (Fig. 1 left). Given the nature of her symptoms, a dynamic contrast-enhanced MR angiogram of the neck was then obtained. This MR angiogram was performed using a 3-T magnet (Verio, Siemens) with a combined head and neck coil. Contrast-enhanced 3D MR angiography sequences (0.6-mm slices) were acquired with the head in a neutral position and then turned to the right. A total contrast dose of 20 ml of Magnevist Gd was administered at 2 ml/sec. Upon rotation of the head to the right there was no filling of the left vertebral artery (Fig. 1 right). A noncontrast CT scan of the cervical spine was performed (Fig. 2), which showed a ventral osteophyte in the C-1 vertebral foramen extending caudally.

Surgery and Postoperative Course. Following a thor-
ough discussion with the patient regarding the different management options, surgical treatment was chosen. She was taken to the operating room and positioned in the lateral decubitus position with the left side up. Her head was secured in the neutral position with pins. The vertebral artery was identified just rostral to the C-1 ring. This was confirmed using Doppler ultrasonography. The C-1 transverse foramen was unroofed and the vertebral artery mobilized. The ventral osteophyte was then removed with a small rongeur. Following decompression and mobilization of the left vertebral artery, the Doppler ultrasonography signal was consistent with good flow through the vessel. The patient’s head was then rotated 90° to the right. The anesthesiologist then infused 5 ml of ICG/water solution intravenously. Robust flow through the vertebral artery could then be confirmed using the videoangiography mode of the specialized microscope (Pentero, Zeiss; Fig. 3A). The patient tolerated the procedure well without complications. She experienced complete resolution of her symptoms and was discharged home on postoperative Day 3. Two months postoperatively the patient underwent dynamic MR angiography showing good vertebral artery flow in the neutral position and during head rotation to the right (Fig. 3B and C).

Discussion
In 1978, Sorenson coined the term “bow hunter’s syndrome” in a publication describing a patient who developed neurological deficits during archery practice. Bow hunter’s syndrome is characterized by neurological symptoms secondary to intermittent vertebral artery occlusion during head rotation. It is often occlusion of the dominant vertebral artery that is responsible for a patient’s symptoms. Our case is unique because it was occlusion of the nondominant vertebral artery that resulted in the patient’s symptoms. Vertebral artery occlusion can be secondary to osteophytes, ligamentous bands, C1–2 instability, or unusual vertebral artery anatomy. Vertebral artery occlusion occurs most often at the level of the atlantoaxial junction. The consequences of these intermittent episodes of vertebral insufficiency vary from transient ischemic attacks to potentially devastating brainstem infarctions.
This syndrome is typically diagnosed using dynamic angiography. Other diagnostic imaging modalities include dynamic CT angiography and dynamic transcranial Doppler ultrasonography. Such studies typically reveal normal filling of the vertebral arteries when the head is in the neutral position and decreased filling or complete occlusion of 1 vertebral artery during head rotation. In our case, there was a concern for stroke/transient ischemic attack and hence MRI and MR angiography of the head and neck was performed. Given the dynamic nature of her symptoms, a contrast-enhanced dynamic MR angiogram was also performed. Our report indicates that dynamic MR angiography presents an alternative noninvasive method for diagnosis. To our knowledge, this is the first-ever report of bow hunter’s syndrome diagnosed using dynamic MRI.

Multiple management strategies have been presented in the literature for bow hunter’s syndrome, including posterior or anterior surgical decompression, C1–2 fusion, conservative management, and more recently, endovascular treatment options. C1–2 fusion is best used when the vascular compromise is associated with atlantoaxial instability. C1–2 fusion can also be effective in the absence of instability, but the loss of motion is undesirable and often unnecessary. Decompression more directly addresses the cause of this syndrome in the majority of cases. Anterior and posterior approaches have been described and the chosen approach depends on location of compression and surgeon preference. There have been several recent publications describing endovascular stenting of the affected vertebral artery with favorable outcomes.

Once surgical treatment is achieved, it is desirable to demonstrate unequivocal efficacy of the surgery intraoperatively. The use of standard intraoperative dynamic angiography and the use of Doppler ultrasonography have been described. In our case we used Doppler ultrasonography before and after decompression. Following decompression, we also evaluated vertebral artery flow using fluorescent angiography. Fluorescent angiography is commonly used in the evaluation of cerebral blood flow during the surgical treatment of cerebral aneurysms, arteriovenous malformations, and extracranial-intracranial bypass. This imaging modality has been found to be rapid and reliable in the evaluation of flow and detection of residual aneurysms or arteriovenous malformations. In our case, ICG angiography provided us with immediate feedback, confirming robust flow through the vertebral artery as it ascends from the C-2 transverse foramen (A) and runs along the sulcus arteriosus on C-1 (B). B and C: Images of the neck with the head turned to the right showing good flow through bilateral vertebral arteries at 2 months (B) and 10 months (C) after surgery.
Intraoperative fluorescent angiography has been previously used in the evaluation of intracranial and extracranial vascular patency. This report is the first to show that this method can offer rapid and reliable intraoperative evaluation of vertebral artery decompression in bow hunter’s syndrome.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following. Conception and design: Anaizi, Berkowitz, McGrail. Acquisition of data: Anaizi, Sayah. Analysis and interpretation of data: Anaizi, Sayah, Berkowitz. Drafting the article: Anaizi. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Anaizi. Study supervision: McGrail.

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