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CEREBRAL CAVERNOMA IN AN ASPIRING BOXER:

‘The Dream Stealer’

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Abstract

Magnetic resonance imaging (MRI) of the brain is a mandatory component of the medical examination required to box professionally in the UK.

Cerebral cavernous malformation (CCM) is an uncommon structural abnormality of the brain present in approximately 1 in 200 people. The condition is associated with spontaneous intracerebral bleeds but is not known to predispose to intracerebral bleed in head trauma. CCM is potentially treatable by surgery or stereotactic radiosurgery.

There is no worldwide consensus on the use of screening MRI in boxing licensing, nor on the possibility of returning to the sport after treatment of structural lesions within the brain.

We report on a case involving the discovery of an asymptomatic CCM on MRI of the brain in a fighter applying for a license to box professionally in the UK. We discuss the lack of consensus in the licensing of such fighters and the medical, social, and ethical issues that arose from this case.

Background

A cavernoma is a cluster of abnormal blood vessels usually found in the brain and spinal cord. A typical lesion looks like a raspberry and is filled with blood which flows slowly through the vessels. CCMs can vary in size from a few millimeters to several centimeters in diameter.

In most cases, the etiology of CCM is unknown. However, radiation and genetics have been shown to play a role in some cases.^{1,2}

The incidence of CCM in the general population is estimated to range from 0.2% - 0.9%, based on findings at autopsy and/or MRI.^{3,4} CCM account for approximately 10% of all cerebrovascular malformations⁵ and are usually detected between the second and fifth decades of life. Their natural history is relatively benign and many patients are asymptomatic. The most frequent manifestations of the disease are seizures, focal neurological deficits, and spontaneous hemorrhage (annual risk 0.7-1.1% in patients with no history of hemorrhage, rising to 4.5% in those with previous cerebral hemorrhage⁶).

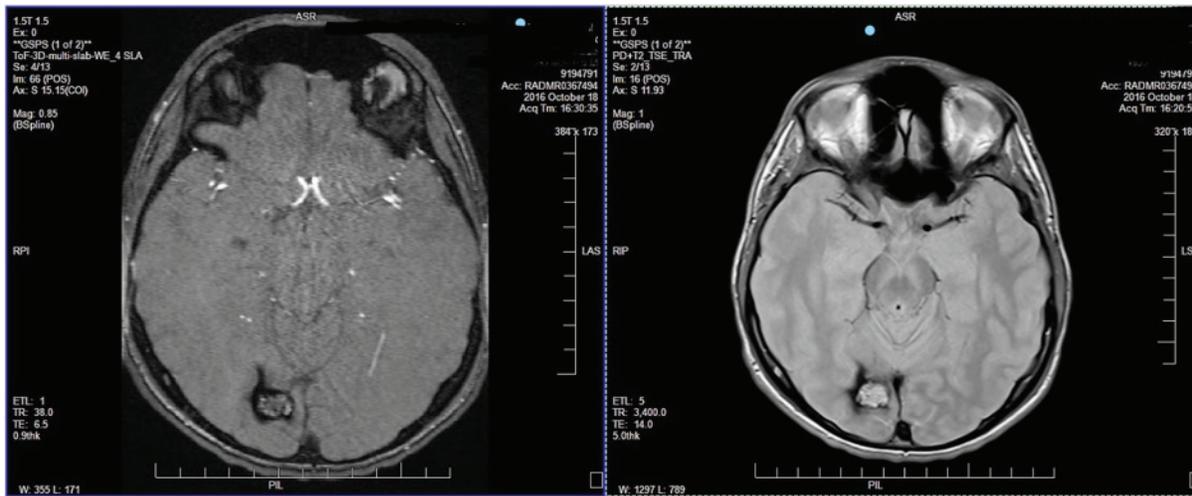


Fig 1. MRI scan, showing a lesion in the right occipital lobe which exhibits the “popcorn” pattern of mixed signal, in keeping with a cavernoma.

The incidence of known, asymptomatic CCM has risen with the increased availability and usage of imaging such as computerized tomography (CT) and magnetic resonance imaging (MRI).

For the purposes of pre-competition medical examination, a CCM is generally considered under the broader classification of arterio-venous malformation, despite being purely venous in nature. Mixed lesions, however, carry a far greater risk of significant bleeding and cannot be considered to be the same.

The management options for CCM include neurosurgical resection via craniotomy, stereotactic radiosurgery, and conservative management. The choice of treatment modality is influenced by the nature of any symptoms and the location of the lesion.

There have been cases of athletes returning to professional boxing at elite level after craniotomy.^{7,8} Notably, Marco Antonio Barrera of Mexico, who had several fights (including in the US) following craniotomy and excision of a cerebral cavernoma in 1997. There have also been examples of boxers, such as Edwin Valero, competing in other countries after being barred from competing in the US following cranial surgery.⁹

Screening MRI is a mandatory component of the medical examination of the British Boxing Board

of Control (BBBofC). However, it is not part of the examination of many international and national governing bodies (including the WBA and IBF) and it is, of course, possible to box professionally in many countries of the world on these licenses.

Case Presentation

Presentation. A 21-year-old male underwent a mandatory MRI of the brain in order to obtain a license to box professionally in the UK. The scan raised concerns within the BBBofC and further clarification was sought with a CT. The subject had been boxing as an amateur from the age of 16, was asymptomatic, and had no medical history which would suggest any neurological disorder. In particular, he had no history of headache, dizziness, visual disturbance, or epileptic phenomena. He believed that a second-degree relative had once been told that they had “abnormal blood vessels” in their brain but could not be more specific.

Imaging results. The MRI and CT images demonstrate a 13mm lesion on the under-surface of the right occipital lobe. It has a “popcorn” pattern of mixed signal on the MRI, in keeping with a cavernoma. The extensive hemosiderin staining around this lesion is indicative of episodes of previous haemorrhage. The lesion is also heavily calcified, with surrounding high attenuation which may represent the noncalcified matrix of the cavernoma.



Fig 2. Unenhanced CT scan of the same area as shown in Fig 1. The lesion in the right occipital lobe demonstrates significant blooming, indicating previous haemorrhagic episodes.

There is some faint calcification and hemosiderin staining at the posterior aspect of the right frontal lobe, in keeping with another small cavernoma. There is also at least one further small area of blooming on gradient echo imaging on the medial aspect of the right cerebellar hemisphere. There is no evidence of acute bleeding on the scans.

Medical management. The boxer was referred to a specialist neurosurgical unit and reviewed by a clinician who specialises in the treatment of such malformations. It was decided that intervention would present greater risks than conservative management. A noninterventional approach was therefore adopted.

Non-medical consequences. The BBBofC took several months to inform the young man that his request for a boxing license was declined. He had worked and trained diligently during his relatively short time in the amateur sport and was considered to have a high potential for success as a professional boxer. Coming from a socially deprived area where violence and drug crime is common, his boxing ability and aspirations elevated him above this norm in the eyes of his family and peers.

Such a pattern is, of course, not unusual in the sport of boxing. He described the cavernoma as his “dream stealer”.

Discussion

The wider availability and use of imaging in many countries has led to an increased detection of known benign structural cranial lesions such as CCM. These can often present as incidental findings on imaging, as in this case, where an MRI was done as part of a medical examination for a professional boxing license. There are few licensing bodies across the world that include routine MRI as part of the medical examination and, indeed, its use in the UK only dates from the mid-1990s.

Previously, the presence of a structural brain lesion was considered an absolute contraindication to participation in contact/collision sports, and the physicians involved typically exercise extreme caution. However, the disadvantages of this approach are also apparent. In addition to the health benefits of sports participation and the growing financial rewards, boxers often come from socially disadvantaged backgrounds, and may lack opportunities for other employment. For these reasons there must be sound reasoning behind ending an athlete’s career, and possibly his or her only source of income.

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Vascular malformations of the brain and combat sports: To fight or not to fight?

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KEY WORDS: vascular malformations; aneurysm; arteriovenous malformation; cavernous malformation; venous malformation; combat sports; boxing; MMA.

DISCLOSURES: NKS serves as Associate Editor, *The Eastern Journal of Medicine*. He also serves as Chief Medical Officer of the New York State Athletic Commission (NYSAC). The views expressed are his and do not necessarily reflect the views of the NYSAC.

Vascular malformations of the brain is an umbrella term for a number of different cerebral vascular malformations each with its own natural history and clinical significance. These include aneurysms, arteriovenous malformations (AVMs), cavernous malformations, venous malformations such as venous angiomas, capillary telangiectasia, vein of Galen malformation and mixed malformations. These malformations may come to clinical attention with headaches, seizures (both focal and secondary generalized convulsions), stroke, hemorrhage but are more commonly detected incidentally when neuroimaging is carried out. The frequent use of advanced imaging techniques such as magnetic resonance imaging (MRI) for a variety of neurological symptoms has led to an increased detection of incidental vascular malformations of the brain.

As stated in a 2017 commentary published in the *South African Journal of Sports Medicine*, “Professional boxing and mixed martial arts (MMA) are popular contact sports with high risk for both acute and chronic traumatic brain injury (TBI). Although rare, combatants have died in the ring/cage or soon after the completion of the bout. The cause of death in these cases is usually acute subdural

hematoma, acute epidural hematoma, subarachnoid hemorrhage, intracranial hemorrhage, or second-impact syndrome (SIS). Neuroimaging or brain imaging is currently included in the process of registering for a license to fight in a combat sport in most states in the United States and around the world. Neuroimaging prior to licensure helps to identify and/or exclude coincidental or clinically suspected brain lesions which may pose a risk for rupture, bleeding or other catastrophic and important brain injury.”¹ However, the required imaging specifics and frequency vary from state to state. In the United States and around the world,¹ For licensure, the NYSAC requires that all combatants must take an approved MRI exam within 3 years of any bout.² Unless otherwise required by the Commission, the following MRI exams are acceptable; either 1.5 Tesla magnet (minimum) or 3 Tesla magnet with the following mandatory MRI sequences: susceptibility weighted imaging (SWI); T1 weighted images; T2 weighted images; FLAIR; Diffusion weighted image (DWI) and Gradient echo (GRE). The Commission further requires that all MRI brain results be submitted at least 3 days before a scheduled bout. With respect to vascular malformations of the brain, the NYSAC Medical Manual states

that combatants with vascular malformations on their MRI scans are not eligible to compete. Combatants with venous anomalies are permitted to fight on a case by case basis after review of the combatant's medical history.²

In this inaugural issue of the Association of Ringside Physicians (ARP) e-journal, Moseley et al. present a 21-year-old male professional boxer applying for a license to box professionally in the United Kingdom. MRI brain led to the discovery of an asymptomatic cerebral cavernoma and denial of boxing license by the British Boxing Board of Control. The authors discuss the lack of consensus in the licensing of fighters with vascular malformations of the brain and the medical, social and ethical issues that arose from their case.³ They highlight the frequently unconsidered cost of denial of license namely the loss of income opportunities for the boxer and his/her family and most importantly the shattering of a dream for no fault of their own.

Risk stratification is the process of identifying the individual risk of a combatant suffering from a particular condition after careful review of history, laboratory and clinical tests. Some combatants may warrant disqualification and denial of license to fight and others may be medically cleared to fight after careful review of all relevant history and imaging findings.

The decision to medically clear or deny a fighter to fight when the brain MRI suggests evidence of a vascular malformation needs further studies looking closely at the natural history of these malformations in combat sports athletes.

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