

A boxer with a pipeline stent in the brain- Should this boxer be allowed to participate in professional boxing fight?

Abstract

Professional boxing is a popular combat sport which unfortunately carries a high risk of acute traumatic brain injury (TBI). The nature of the sport is such that every punch thrown to the opponent's head is thrown with the intention of winning by causing a concussive head injury (aka a knockout). Professional boxing is regulated by various State Athletic Commissions in the United States and abroad. Most commissions require an imaging study of the brain (either a computed tomography scan or a magnetic resonance scan) prior to licensure. The primary goal of neuroimaging prior to licensure is to identify and/or exclude coincidental or clinically suspected brain lesions which may pose a risk for rupture, bleeding, or other catastrophic brain injury during a bout/training. These lesions include aneurysms, arteriovenous malformations, cavernous malformations, large venous malformations, Vein of Galen malformations among others. A boxer with history of a left ophthalmic artery aneurysm status post embolization with placement of a pipeline shield in the distal left internal carotid artery (ICA) presented for licensure. Should this boxer be allowed to participate in professional boxing is debated.

Keywords: boxer, aneurysm, stent, arteriovenous malformations

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Case report

A 29-year-old undefeated male professional boxer presented for initial licensure. MRI brain without contrast was reported as normal with no gross aneurysm seen. In the MRI report under clinical history mention was though made of "prior history of embolization of cerebral aneurysm". The boxer was not cleared to fight and magnetic resonance angiography (MRA) head without contrast was requested for further characterization. MRA head revealed that the boxer was status post prior embolization with placement of pipeline shield in the distal left ICA covering site of left ophthalmic artery aneurysm. Diminished flow related enhancement/caliber of the distal left ICA at the site of the placed stent/shield was noted. No flow related enhancement was seen at the site of the prior left ophthalmic artery aneurysm. After review, the boxer was denied licensure to fight on medical grounds.

Discussion

Most Athletic Commissions require an imaging study of the brain as a prerequisite for licensure to box professionally. Neuroimaging is requested prior to licensure for 2 main reasons. First it helps identify and/or exclude coincidental or clinically suspected brain lesions which may pose a risk of rupture and sudden catastrophic bleeding in the ring. These lesions include cerebral aneurysms, arteriovenous malformations, cavernous angiomas, large venous malformations, vein of Galen malformations among others. The second utility of neuroimaging is to identify structural evidence of prior TBI.¹ While acute TBI is common, the burden of chronic neurological injuries in boxing is also exceptionally high. Identifying evidence of chronic TBI in a boxer aids ringside physicians in prognostication for the risk of future neurological sequelae such as chronic traumatic encephalopathy, dementia pugilistica, posttraumatic dementia, chronic post-concussion syndrome and posttraumatic Parkinsonism among others.^{1,2}

Neuroimaging requirements vary widely from commission to commission in the United States and abroad. Some commissions do

not require any imaging, some require imaging only if the boxer is above a certain age deemed high-risk, CT scan head is the requirement in some, in others it is MRI brain.¹ Apart from imaging modality, the specifics and frequency of imaging also vary. New York requires MRI scans to be done either on a 1.5T or 3T machine and specifically requests susceptibility weighted imaging and gradient echo imaging sequences. In some commissions neuroimaging is only required once at the time of initial licensure, in others it needs to be repeated every 1 to 5 years. A few commissions require that all combatants undergo MRA head in addition to MRI of the brain at the start of their professional career to primarily exclude any incidental vascular malformations of the brain, in others this is a requirement only if the combatant is over the age of 40.

The case raises several discussion points. In the boxer presented above, MRI brain was reported normal. If the MRI report under clinical history did not make mention of "prior history of embolization of cerebral aneurysm" he would have been cleared to box. It was only when MRA brain was obtained that his pipeline shield/stent was identified and appropriate risk stratification of the athlete could be carried out. Neuroimaging requirements should be standardized across the board and all combatants irrespective of their age should undergo MRA head in addition to MRI brain at the start of their professional career. MRI brain should be repeated every 3 years thereafter. More frequent imaging may be requested on a case-by-case basis when imaging suggests evidence of an abnormality, prior/chronic TBI, or change from baseline.

There is consensus among experts that a combatant with a cerebral aneurysm not be licensed to fight. But should a combatant with a prior history of aneurysm which has been successfully embolized with a flow-diverter device (FDD) be allowed to fight? Is it medically safe for this boxer to ply his trade? A PubMed search with search terms "cerebral aneurysm", "pipeline stent" and "boxer" retrieves zero results. Pipeline stent is a new generation FDD placed in the parent artery at the level of the aneurysmal neck to disrupt intra-aneurysmal flow promoting intra-aneurysmal thrombosis. The Silk

(Balt Extrusion, Montmorency, France), the Flow Re-direction Endoluminal Device (FRED) (Microvention, Tustin, CA, USA), the p64 Flow-Modulation Device (Phoenix, AZ, USA) and the Surpass Flow-Diverter (Surpass; Stryker Neurovascular, Fremont, CA, USA) are the other FDD along with the pipeline embolization device (PED) (Covidien, Mansfield, MA, USA), currently approved for the treatment of intracranial aneurysms.³ These devices are increasingly becoming the preferred alternate to endovascular occlusion with coils especially for unruptured wide neck and complex anatomy aneurysms. Briganti et al. in their systematic review of endovascular treatment of cerebral aneurysms using FDDs found mean rate of complete aneurysm occlusion was 81.5% (range 69%-100%).³ Aneurysm occlusion occurs within several months so bleeding can theoretically occur even after the procedure. Post-procedure patients are started on dual antiplatelet therapy (aspirin+clopidogrel) to prevent in-stent and parent artery thrombosis. This though may increase the risk of bleeding from a still not occluded or incompletely occluded aneurysm. There is currently no consensus on the best dual antiplatelet regimen and duration of antiplatelet therapy.³⁻⁵

A professional boxer sustains many head impact exposures (HIEs) during a bout. HIEs also occur during sparring. While the rate of complete aneurysm occlusion with FDD is high, it occurs over several months. The patient is also placed on dual antiplatelet therapy. During this time frame it is prudent that all head impact exposures be avoided. Thus, a combatant should be counseled not to spar and denied license to box immediately following endovascular treatment of cerebral aneurysm using a FDD. At present it is unclear whether it is safe for a boxer to fight professionally after dual antiplatelet therapy is stopped and complete aneurysm occlusion is documented.

Conclusion

It is unclear whether it is medically safe for professional boxers who are status-post successful endovascular embolization of cerebral

aneurysms with FDDs to box. More studies in this special patient subpopulation are needed.

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Conflicts of interest

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