Cerebral arteriovenous malformation (AVM) is a rare, idiopathic condition that occurs in 1% of the general population, occurring when arteries in the brain connect directly to nearby veins with a lack of capillaries between them. Absence of capillaries decreases gas exchange across the vessels and may cause blood pooling within the brain. Pressure or trauma to the blood vessel may cause the AVM to rupture, reducing blood flow to the brain tissue. This condition is believed to be congenital, and patients may be asymptomatic until later in life (15 to 20-year-old patients present symptoms most often). A secondary and potential fatal complication of AVM is cerebral aneurysm, which is a widening or ballooning of a blood vessel due to weakness of its wall. Cerebral aneurysm is potentially avoidable if identified and early intervention is implemented. Although rare, the potential complications associated with AVM rupture require that clinicians have knowledge of the key clinical features to both discriminate it from nonemergency conditions and to ensure appropriate and expedient interventions. The following case report reviews diagnostic procedures, surgical management, and return to participation for a collegiate football athlete with an AVM rupture.

Case Review

A healthy 18-year-old collegiate football athlete reported to the athletic training staff during spring practice that he was experiencing an intense headache, cervical pain, and photosensitivity. He was removed from practice within 10 minutes after the onset of symptoms. The athlete reported no previous history of severe headaches. When describing the initial onset of symptoms, he reported feeling a “pop” in his head, which was followed by immediate pain as he performed single-leg bounding exercises. The pain was localized over the posterior portion of his head and neck. Vital sign measurements demonstrated slightly elevated oral temperature (99.8°F) and normal blood pressure (116/72 mmHg). He was alert and oriented but uncharacteristically apprehensive. Cervical range of motion (ROM; active, passive, and resistive) was assessed to identify the possible source of his cervical pain, which demonstrated normal results. The atraumatic nature of the injury, absence of concussion-like symptoms, and normal cra-
nial nerve function ruled out traumatic brain injury. During functional movements (similar to the dynamic warm-up activities) and any bounding activity, the athlete reported increased pain deep in the right occipital region. Meningitis and encephalitis testing (Kernig’s and Brudzinski’s tests) yielded negative results. Migraine headache was initially suspected as the cause of the athlete’s symptoms. The athlete returned to the athletic training facility approximately 1 hour postpractice with intensified symptoms, and he was transported to the emergency room for further evaluation. Computed tomography (CT) imaging revealed an acute intraparenchymal hemorrhaging near the right thalamus, with intraventricular extension in the right lateral, left lateral, third, and fourth ventricles. A CT angiogram revealed a 1.8 cm AVM of the right thalamus, with no cerebral aneurysm. After two days of bed rest in the hospital, magnetic resonance imaging (MRI) suggested reabsorption of the intraventricular blood (Figures 1 and 2) and the athlete was discharged. He remained under 24-hour supervision (with family) to ensure safe recovery.

**Initial Management and Surgical Intervention**

After 2 weeks of complete rest and administration of pain medication (acetaminophen – 400mg every 6 hours), the athlete was seen by a neurosurgeon to discuss management options. The patient chose to have a surgical intervention performed, rather than a pharmacological treatment option. Nonsurgical management would have presented greater likelihood that the patient would experience another cranial bleed if he returned to sport participation. Surgical intervention would allow for the athlete’s return to sport after a latency period (e.g., 1–2 years) and a lesser likelihood for relapse. Due to the size and location of his AVM, a stereotactic radiosurgery procedure offered the greatest potential for success. Stereotactic radiosurgery uses focused radiation to scar, shrink, and obliterate the AVM. During the closed surgical procedure, the patient’s head was fixed in a halo brace and 20-25 Gy (units of radiation dosed as absorbed energy per unit mass of tissue) bursts of energy were delivered; the entire procedure lasted 43 minutes. After postoperative imaging suggested that shrinkage of the AVM had occurred, no additional radiation treatment was deemed necessary. The patient was prescribed Warfarin to reduce risk of clotting or aneurysm. The Warfarin dosage prescribed by the physician maintained the patient’s international normalized ratio (INR) between 2.0 and 3.0; a high INR indicates a slower time to clot (i.e., bleeding risk) and a low INR indicates a faster time to clot (i.e., clotting or thrombosis risk). After a 6-month activity restriction following the radiosurgical procedure, the athlete was asymptomatic and allowed to begin strength training limited to body weight resistance, and the use of Warfarin was discontinued. During the following month, the athlete incorporated isotonic strength training, plyometric and sport-specific drills (e.g., cutting, speed training, bounding, etc.), progressing his training program as tolerated. After 12 months, the athlete was cleared for full participation in football. He is required to have annual follow-up