ELSEVIER

Techniques in Vascular and Interventional Radiology

Elbow Artery Embolization for Lateral Epicondylitis

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Lateral epicondylitis, also known as tennis elbow, is characterized by a low-grade inflammatory process in the lateral aspect of the elbow. Symptoms are typically treated conservatively, and most patients show resolution or improvement of symptoms within a few months. For those with refractory symptoms, treatment options are limited with questionable benefit. Embolization of the arteries supplying the elbow decreases the neo-vascularity seen in epicondylitis. The procedure may result in marked improvement in pain and function, which has shown to be durable.

Background

The lateral epicondyle of the elbow connects the wrist extensor muscles. Overuse injury involving the proximal tendons of the extensor carpi radialis brevis (felt at tip of lateral epicondyle) and the extensor digitorum communis muscle (felt just posterior and distal to tip of lateral epicondyle) constitutes lateral elbow epicondylitis.[1] This is commonly called "tennis elbow." Tennis can commonly cause lateral elbow epicondylitis, commonly termed as “tennis elbow.” However, numerous other occupational and recreational activities with similar repetitive motions are causative factors. Factors that correlate with a poorer prognosis include high physical strain at work, dominant side involvement, concomitant neck pain (with or without signs of nerve root involvement), duration of symptoms greater than three months, and severe pain at presentation.

Elbow tendinopathy represents a chronic tendinosis, not necessarily an acute inflammatory process, involving disorganized tissue and neovascularity within the tendon. Studies using grayscale ultrasonography and color Doppler followed by anesthetic injection show that the development of neovessels in the common extensor origin is associated with pain in lateral epicondylitis. Targeting this degenerative tendinosis and neovascularization is the focus of embolization.

Diagnosis is based on history and physical exam, with radiographs used to exclude other pathology. Pain is present over the lateral epicondyle of the humerus. With the elbow in full extension, the examiner places his hand at the patient’s elbow, and with the other hand resists the patient’s extension of his wrist. Pain is elicited at the elbow. A second test is to elicit pain with passive wrist flexion while the elbow is extended.

Conservative treatment consists of rest, use of a brace, physical therapy, and use of non-steroidal anti-inflammatory medications.[2] Anti-inflammatories have been a mainstay of the treatment of elbow tendinopathy for many years, although supporting evidence consists of anecdotal success and a few limited studies.[3] For short-term relief of severe symptoms, a single glucocorticoid injection is a reasonable treatment option when used as part of a comprehensive management program including physical therapy.[4,5] While glucocorticoid injection may result in short-term benefit, physical therapy has been shown to be more effective than injections at one year.[4] However, none of these treatments have shown to result in long-term improvement. Studies of surgical management are scant.[6-8]

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Similar to genicular artery embolization for knee osteoarthritis, the mechanism of elbow artery embolization is to reduce the arterial neovascularity in the elbow.[9] The elbow receives its blood supply from branches of the brachial artery: the radial recurrent artery, interosseous recurrent artery, and radial collateral artery. Deliberate partial blockage of the one of these arteries (embolization) leads to reduction of the inflammatory response, with potential improvement in pain. The radial recurrent and interosseous recurrent are the most commonly involved arteries in this process. When the target abnormal neovascularity is not observed from either of these two arteries, the artery feeding the affected area is often a branch of the brachial deep artery.

Technique

Elbow artery embolization is performed in the Interventional Radiology suite, and moderate sedation is typically used. Given the minimally invasive nature and short duration of the procedure, sedation is not mandatory. Immediately prior to the procedure, the appropriate elbow is be marked. Discern areas of focal point tenderness and place a radio-opaque BB marker. Administer prophylactic intravenous antibiotics, based on institutional standard of care Fig. 1.

The authors prefer an ipsilateral radial approach for elbow artery embolization. The short distance from the radial artery access point to the elbow makes catheterization of the branch elbow arteries straightforward. Local anesthesia should be administered for a transradial approach. Access of the radial artery is done with a 21-gauge needle, with exchange to a 5 French glide-coated sheath. A 4 or 5 French multi-sidehole straight flush catheter is inserted and positioned in the proximal brachial artery, and digital subtraction angiogram is performed. Then, selective catheterization of the specific arteries that are supplying the areas of the patient's pain (eg, radial recurrent artery, interosseous recurrent artery, and radial collateral artery) is done with a 1.7-2.0 French microcatheter. The microcatheter can be advanced with the support of a 4 or 5 French angled glide catheter, or simply directly via the radial sheath. If hypervascularity is seen, embolization is performed with a particle embolic. Prior to embolization, an ice pack can be applied to the skin in order to minimize nontarget embolization via cutaneous branch feeders. The authors prefer imipenem/cilastatin (Primaxin; Merck, Whitehouse Station, NJ) or 100 micron Embozene particles (Varian Medical Systems, Palo Alto, CA), suspended in a diluted solution of contrast and saline. The procedural endpoint is lack of distal hypervascularity, with preservation of normal arterial flow. Arterial stasis should not be achieved. Once the embolization procedure is complete, follow institution's standard of care for catheter and introducer removal and closure of radial/femoral puncture.

Patients are discharged with an oral nonopioid analgesic, typically 2 hours after the procedure.

Outcomes Assessment

Improvement in symptoms typically occurs within a month of the procedure. Various measurement tools have been used to assess treatment outcomes for lateral epicondylitis. The

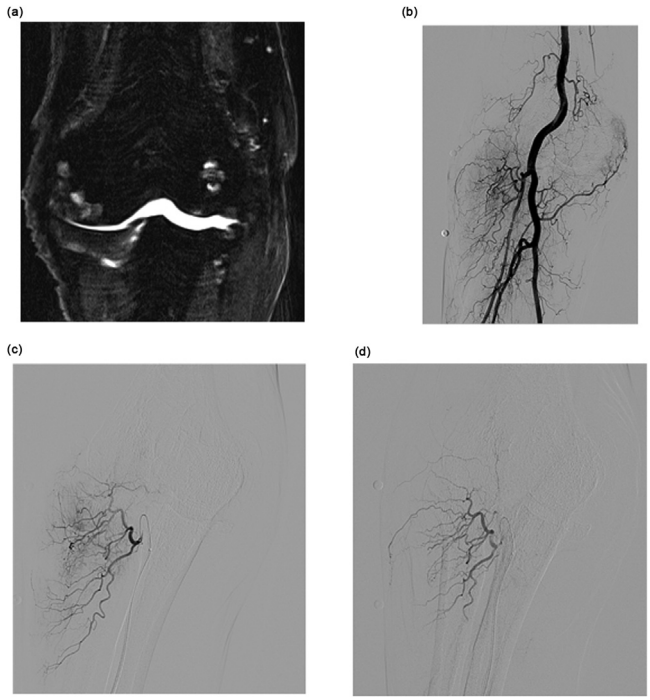

Figure 1 MR of the elbow shows small joint effusion and edema of the proximal radius and lateral humeral condyle (a). Digital subtraction angiogram of the brachial artery shows hyperemia of the lateral elbow at the area of the patient's pain, marked by a radio-opaque marker (b). Selective catheterization of the radial recurrent artery demonstrates hyperemia of the lateral elbow (c). After embolization, hyperemia has resolved with patency of the proximal vessels (d).

QuickDASH (Disabilities of the Arm, Shoulder, and Hand) is a commonly used, well validated tool in the orthopedic surgery literature.[10,11] It is scored on a scale from 1 to 100, with 100 being the worst score. The minimally clinically important difference (MCID) is reported to be a reduction of 9-11 points, out of a total score of 100.[12] Therefore, 50% reductions in QuickDASH will typically be far in excess of the MCID, given that the average baseline score is expected to be greater than 50/100. Most studies of injection or surgical intervention have not shown a 50% reduction in QuickDASH that remains sustained over a period of more than several months.

The Patient-rated Tennis Elbow Evaluation (PRTEE) enables quantitative rating by the patient of pain and functional impairment associated with tennis elbow or lateral elbow tendinopathy. Unlike the QuickDASH which measure function of the entire extremity, PRTEE is specific to the elbow.

In 2017, Iwamoto and colleagues reported their experience with elbow artery embolization.[13] Their prospective trial enrolled 24 patients with lateral epicondylitis. All patients had pain that was resistant to conservative treatment, such as oral nonsteroidal ant-inflammatory drugs, physical therapy, or intra-articular steroid injection. The procedure was technically successful in all patients. Tissue necrosis, dermal ulcers, muscle weakness, or peripheral paresthesia did not arise in any embolized territory during the follow-up period. The mean QuickDASH (Disabilities of the Arm, Shoulder, and Hand) score before embolization significantly decreased at every follow-up visit (50.8 ± 14.2 vs 23.4 ±

15.3, 8.3 ± 6.5, 5.3 ± 5.3, 2.5 ± 2.2, and 2.7 ± 2.8; all $P < 0.001$). The intention-to-treat clinical success rate at 6 months after the first embolization procedure was 88% (95% confidence interval, 68%-97%). The mean maximum pain score visual analog scale, VAS) before treatment significantly decreased at 1, 3, 6, 12, and 24 months (77 ± 15 mm vs 49 ± 28 mm, 31 ± 22 mm, 16 ± 13 mm, 9 ± 13 mm, and 11 ± 14 mm, respectively; all $P < 0.001$).

The embolic material used in their study was imipenem−cilastatin sodium (IPM-CS). This compound is slightly soluble in water, and when suspended with a contrast agent, it forms crystalline particles that exert embolic effects. While more commonly done in Japan, this compound is not routinely used as an embolic agent in the United States. Instead, spherical particles are routinely used in most applications for embolization.

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