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Case Report

Upper extremity tumor embolization using a transradial artery approach: technical note

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ABSTRACT

Transradial access is being used with increasing frequency for interventional radiology procedures and offers several key advantages, including decreased access site complications and increased patient comfort. We report the technique of using transradial access to perform preoperative embolization of a humeral renal cell carcinoma metastasis and pathologic fracture. A transradial approach for performing humeral preoperative tumor embolization has not been previously reported, to our knowledge. In the appropriately selected patient, this approach may be safely used to perform upper extremity embolization.

Introduction

Radial artery access is increasingly used in percutaneous coronary intervention (PCI) in part due to lower vascular complication rates and improved patient comfort [1]. Transradial access has been adopted to some degree as well for interventional radiology procedures, such as uterine fibroid embolization [2]. Nevertheless, preoperative embolization of osseous metastases from hypervascular tumors (such as renal cell carcinoma [RCC]) is traditionally performed through transfemoral access. We describe a case of a patient with RCC presenting with right upper extremity pain found to have a lytic lesion of the right humerus (subsequently biopsy proven RCC metastasis). To our knowledge, we present the first reported case of preoperative humeral tumor embolization performed through transradial artery access.

Case report

A 76-year-old man presented to the emergency room complaining of right upper extremity pain. The pain developed after heavy lifting and gradually progressed to difficulty lifting the arm over the next several days. Outside hospital evaluation revealed a mildly displaced right humeral midshaft fracture with associated lytic lesion. The patient was referred

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to our institution for further evaluation and management. On arrival, the patient was in severe 10/10 pain, and physical examination was significant for right upper extremity tenderness and immobility.

The patient's medical history was notable for RCC status after left radical nephrectomy 10 years prior. Given the appearance of the lesion and the age and history of the patient, differential diagnosis included metastatic disease, with primary malignancy and benign entities such as osteomyelitis or brown tumor considered less likely. Laboratory tests demonstrated normal white blood cells (5.5 K/uL) and Ca (8.7 mg/dL) with no evidence of infection, hyperparathyroidism, or monoclonal proteins, thereby making brown tumor, osteomyelitis, multiple myeloma, or plasmacytoma unlikely. Preoperative laboratory tests demonstrated Hgb, 12.1 g/dL; Hct, 36.9%; Plt, 274 K/uL; international normalized ratio, 1.0.

Imaging

Outside hospital humerus radiographs (Fig. 1) revealed pathologic fracture of the right humeral midshaft with associated lytic lesion. Subsequent computed tomography-guided biopsy (Fig. 1) confirmed RCC metastasis.

Interventions

Before obtaining radial artery access, modified Allen's test was performed using pulse oximetry and plethysmography as described by Barbeau et al [3], confirming palmar arterial supply through the ulnopalmar arcade. In addition, ultrasound was performed and demonstrated the radial artery to be of adequate diameter for safe access and sheath placement. After induction of general anesthesia, right radial access was obtained with a Terumo 4-French radial artery access kit, and a 4-French sheath was placed (Terumo Medical, Somserset, NJ, USA). Nitroglycerin 200 μg and verapamil 2.5 mg were administered through the arterial sheath simultaneously to prevent arterial spasm and to reduce vascular tone. In addition, 3000 units of heparin were administered intravenously to minimize the risk of radial artery thrombosis. A 0.035-angled Glidewire (Terumo) and 4-French Kumpe catheter (Cook Medical, Bloomington, IN, USA) were used together to access the right subclavian artery. An angiogram of the right upper extremity was performed revealing a hypervascular tumor at the site of the displaced proximal humeral fracture (Fig. 2). The tumor demonstrated a complex blood supply via numerous branches of the right brachial artery and the posterior circumflex humeral artery. The catheter and guidewire were then used in conjunction to subselect a branch of the right brachial artery feeding the tumor. The wire was exchanged for a Renegade HI-FLO microcatheter (Boston Scientific, Marlborough, MA, USA) and a Fathom-14 guidewire (Boston Scientific), which were advanced into a tertiary arterial branch. Embolization with 300-500 μ and 500-700 μ Embospheres (Merit Medical Systems, South Jordan, UT, USA) was attempted but discontinued due to early draining vein visualization. The decision was made to carefully administer the higher viscosity Onyx-34 liquid embolic agent (Covidien, Mansfield, MA, USA) with caution to prevent deep venous reflux. Embolization to stasis was performed successfully with Onyx-34.

Postembolization angiography displayed additional tumor supply from an additional brachial artery branch (Fig. 2). After subselection using the microcatheter system, embolization was performed again with 500-700 μ Embospheres and Onyx-34. Embolization to stasis was repeated in one additional

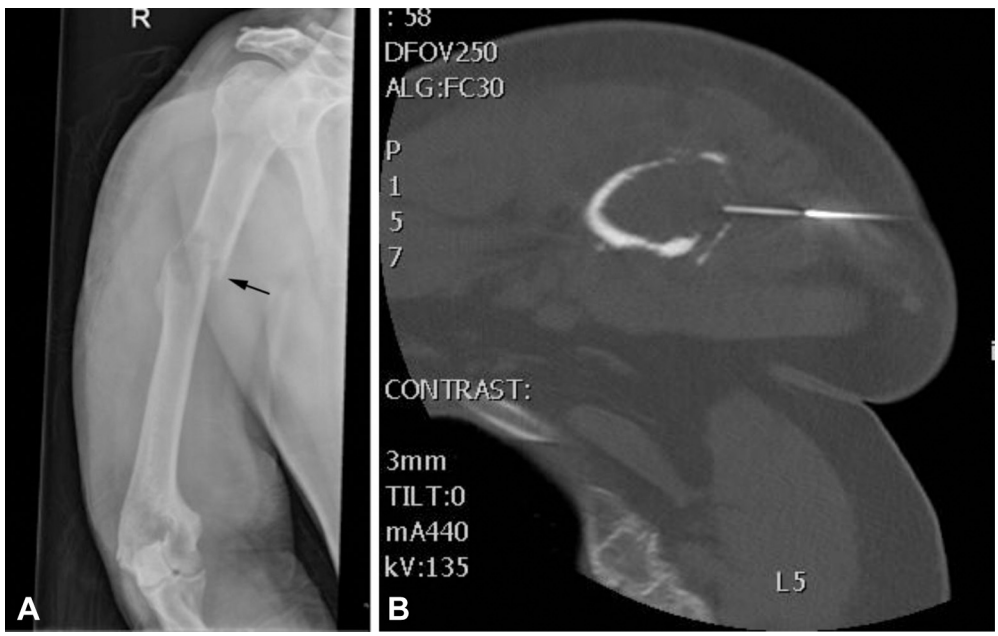

Fig. 1 – (A) Preoperative right humeral radiograph demonstrates a mid-diaphyseal fracture with surrounding lucency concerning for pathologic fracture. (B) Intraprocedural computed tomography scan during biopsy demonstrates needle within the lucent mass, subsequently pathologically proven to be RCC metastasis.

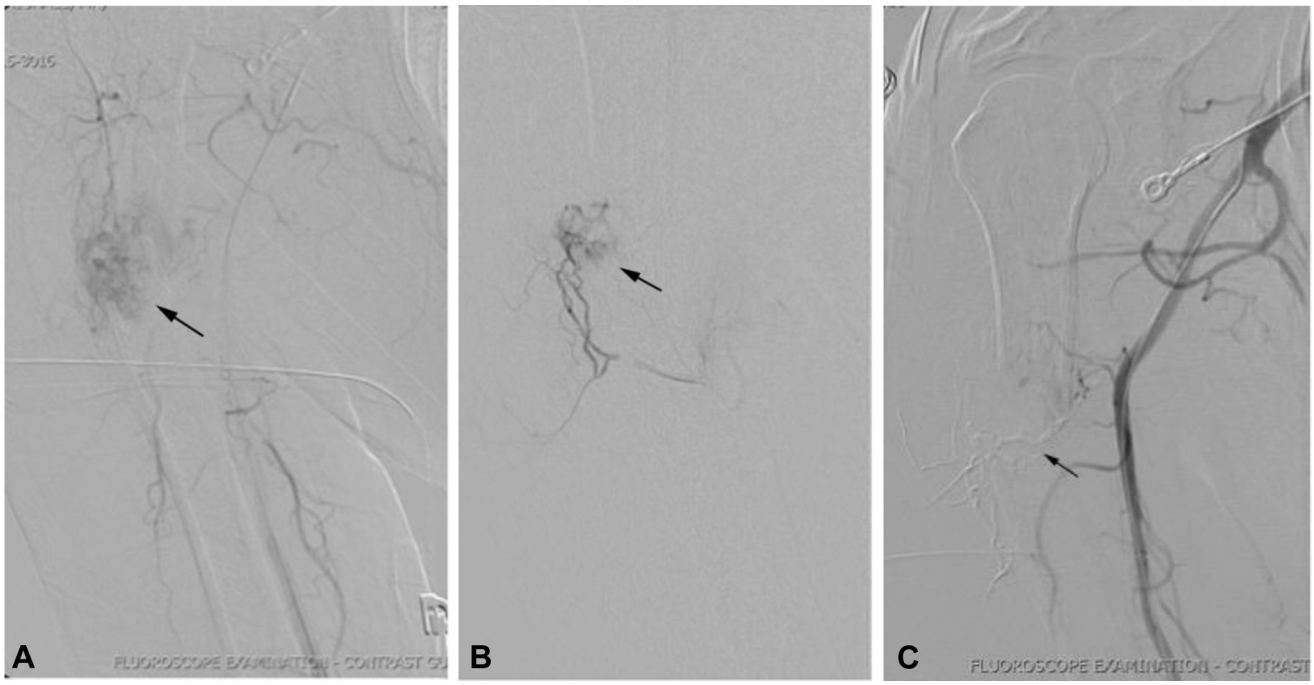

Fig. 2 – (A) Pre-embolization angiogram performed from the right subclavian artery demonstrates a hypervascular mass at the site of pathologic fracture. (B) Selective angiogram before embolization of an inferior branch of the brachial artery providing tumor supply (the second of 4 branch vessels embolized). (C) Postembolization angiogram after the fourth and final embolization performed via the subclavian artery demonstrates significantly diminished tumor vascularity, with minimal residual enhancement.

branch from the brachial artery and one branch from the posterior circumflex humeral artery. In all, 4 tertiary tumor branches were embolized to stasis, 3 arising from the brachial artery, and 1 from the posterior circumflex humeral artery. A final angiogram from the right subclavian artery demonstrated significantly reduced tumor vascularity (Fig. 2). The catheter was removed from the radial access site, and hemostasis was achieved with a TR band (Terumo). The patient was immediately transferred to the operating room, where the orthopedic surgery service performed open reduction and internal fixation. The patient underwent successful right humeral curettage, lesion cementing, and open reduction and internal fixation (Fig. 3). Estimated surgical blood loss was 500 mL.

Discussion

Up to one-third of patients with RCC have metastases at presentation, with 80% of patients eventually developing metastases; nearly half of these patients have bone metastases [4]. Pathologic fractures associated with metastatic RCC usually cause significant functional morbidity. Although surgical treatment of fracture may lead to restoration of function, hypervascularity of RCC metastases often contributes to uncontrollable intraoperative hemorrhage and technical difficulties during surgery [4]. During the pre-embolization era, intraoperative blood loss was reported from 2 to 18.5 L, with a mean of 6.8 L; preoperative embolization has brought about significant reductions in blood loss [4]. Accurate targeting of embolic materials to tumor-feeding vessels and occlusion of tumor capillary bed helps avoid collateral vessel recruitment and leads to more complete tumor devascularization. In fact, obliteration of tumor stain more than 70% has been found to be associated with more effective control of operative hemorrhage without compromising postoperative bone healing [4]. Chatziioannoul et al [5] reported that complete tumor devascularization reduced blood loss and transfusion requirement (mean operative blood loss of 535 mL), whereas partial tumor devascularization was associated with much greater blood loss during surgery and transfusion requirement (mean blood loss of 1247 mL).

The choice of embolic material is determined by many factors, including operator experience and preference [6]. Potential agents include polyvinyl alcohol (PVA) particles, Embospheres, gelfoam (gelatin sponge), embolization coils, as well as liquid embolics, which include absolute alcohol and Onyx. PVA is relatively inexpensive, but its irregular outline may lead to particle aggregation. Embospheres demonstrate easy passage through microcatheters with little tendency to clump after injection compared with PVA due to their uniform size. Because gelfoam acts as a temporary occluding agent, there is the potential for early vessel recanalization. Embolization coils are usually reserved for occlusion of larger vessels and in emergent cases [6]. Intra-arterial ethanol injection has the potential disadvantages of angionecrosis and normal tissue damage [6]. In contrast to agents such as PVA and gelfoam, Onyx is permanent and may provide deep tumor penetration producing extensive intratumoral infarction [6].

Fig. 3 – Immediate postoperative humeral plain film after mass curettage and fracture reduction and internal fixation. Overall intraoperative blood loss was 500 mL.

Although there are studies reported on transarterial embolization (TAE) as preoperative measures to devascularize osseous metastases to the spine and extremities, TAE of the humeral metastasis using the radial arterial approach has not been described to our knowledge. The transradial route was appealing in our case due to the proximity of the tumor to access site. Transradial access offers several advantages. For upper extremity interventions, transradial access eliminates the need to traverse the aortic arch with endovascular devices, thus avoiding the risk of embolizing atherosclerotic debris to the cerebral circulation. In addition, vascular complications are lower with radial access than femoral access; in a large randomized trial comparing PCI by radial and femoral artery access, radial access demonstrated significantly lower rates of major vascular complications such as large hematomas and pseudoaneurysms than the femoral access cohort [7]. Furthermore, this study also found that radial artery access was more commonly preferred by patients for subsequent procedures [7].

Notably, there are limitations with transradial arterial access. First, Kiemenei et al [8] reported that target site cannulation failure was more likely to occur with transradial and transbrachial access due to inability to puncture artery, smaller arterial lumen, or radial artery spasm (failure rate of 4.6% in transradial group, 0.3% in transfemoral group). If one failed to cannulate the distal radial artery, selection of a different artery may be more appropriate since the proximal part of the radial artery takes a deeper course and hemostasis may be more difficult to achieve. To reduce vasospasm associated with the radial artery approach, intra-arterial administration of nitroglycerin, calcium channel blockers, or xylocaine can be considered. And although the overall rate of major vascular complication was shown to be lower in radial artery access than femoral artery access patients for PCI, complications can still occur (such as large hematoma, pseudoaneurysm, and rarely ischemic limb requiring surgery) [7]. Experience and expertise may also play a factor, as centers performing higher numbers of radial procedures seemed to demonstrate better outcomes (whereas the converse was not found for femoral access) [7].

Conclusions

In summary, we present a successful report of the use of transradial access for preoperative embolization of a hypervascular humeral RCC metastasis. TAE should be considered preoperatively for primary or secondary hypervascular bone tumors as palliative measures in inoperable cases and to reduce heavy intraoperative blood loss in appropriate surgical candidates. Our case report demonstrates that transradial approach TAE can be safely performed for upper extremity lesions in patients with normal modified Allen tests [3] and may provide advantages of reduced access site complications, increased patient comfort, and easier achievement of post-procedural hemostasis.

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