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Technical note

Pre-operative embolization of hypervascular spinal metastasis using percutaneous direct intra-tumoural injection with Onyx under local anesthesia

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ABSTRACT

Intra-operative blood loss remains a major cause of perioperative morbidity for patients with hypervascular spinal metastasis undergoing surgery. Pre-operative embolization is used to reduce intraoperative blood loss and operative time. This is commonly performed under general anesthesia via a trans-arterial approach, which carries a risk of spinal stroke. We propose an alternative technique for embolization of hypervascular metastases using the Onyx embolic agent via a percutaneous direct intra-tumoural injection under local anesthesia and sedation to reduce embolization risks and procedure time, as well as operative blood loss and operative time. A 74-year-old man presented with thoracic myelopathy with back and radicular pain on background of metastatic renal cell carcinoma. Magnetic resonance imaging (MRI) revealed a 3 cm mass centered on the right lamina of T10 with extension into the spinal canal. The patient underwent a percutaneous imaging-guided direct intra-tumoural contrast parenchymogram, and Onyx embolization via a single needle. Initial needle placement and tumour assessment was completed in 30 min; embolization time was 15 min. Complete devascularization was achieved with no complications. Surgical resection was performed with lower than expected operative blood loss (150 ml) and operative time (90 min). His pre-operative symptoms improved, and he was discharged home the following day. At 6-month follow-up there was no recurrence of his symptoms. Further evaluation of direct percutaneous intra-tumoural Onyx embolization for hypervascular spinal tumours is warranted.

1. Introduction

Intra-operative blood loss is a major cause of perioperative morbidity for patients with hypervascular spinal metastasis undergoing surgery. Pre-operative embolization is increasingly used as part of the therapeutic arsenal for managing hypervascular spinal metastases to reduce operative blood loss and operative time [1,2]. Patients with renal cell carcinoma (RCC) metastasis have a significantly higher risk of intra-operative blood loss compared to other tumour types and benefit from pre-operative embolization [3–5].

Almost all reports of spinal RCC embolization have been performed using an endovascular trans-arterial approach. Initial spinal angiography is used to characterize the tumour arterial pedicles, and to identify normal blood supply to the spinal cord that may be at risk during embolization. Procedures are typically performed under general anesthesia to improve patient comfort while reducing patient motion and image distortion, particularly when assessing blood supply of the spinal cord [5,6]. During embolization, intermittent spinal angiography is performed to evaluate the effectiveness of devascularization, to check for non-target embolization and to assess for new collateral pathways that have been recruited during embolization that may contribute to normal spinal cord blood supply. Thus trans-arterial embolization does carry a small risk of spinal stroke [7]; the overall procedural permanent complication rate is <1% [2].

The most commonly used embolic agents for pre-operative spinal embolization are the particulate embolic materials, such as polyvinyl alcohol (PVA) particles and gelatin products (gelatin sponge particles or microspheres) [2]. A more recent alternate embolic agent, the ethylene vinyl alcohol copolymer liquid embolic system (Onyx; Covidien Neurovascular, Irvine, California) is

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increasingly being used for pre-operative embolization prior to tumour excision. For hypervascular tumours amenable to percutaneous access, imaging-guided direct intra-tumoural Onyx embolization is reported to significantly reduce operative blood loss compared to trans-arterial particulate embolization [8,9].

In this report, we propose an alternative technique for embolization of hypervascular spinal metastases using the Onyx embolic agent via a percutaneous direct intra-tumoural injection under local anesthesia and sedation to reduce embolization risks and procedure time, as well as operative blood loss and operative time.

2. Case report

2.1. History and examination

A 74-year-old man with known metastatic RCC treated with nephrectomy, chemotherapy and previous partial lung lobectomies, and prior myocardial infarct presented with lower thoracic back pain associated with lower limb pain and paresthesia. There was recent onset of urinary and bowel incontinence without significant gait disability. On examination, there was lower midline thoracic tenderness with normal lower limb power, sensation and reflexes.

2.2. Neuroimaging findings

Computed tomography (CT) imaging revealed a soft tissue mass centered in the right T10 lamina, with invasion into transverse and spinous processes. The mass extended anteromedially into the spinal canal. (Fig. 1A and B) Magnetic resonance imaging (MRI) confirmed the 3 cm mass that distorted the thecal sac and caused displacement of the spinal cord. (Fig. 1C and D). There was no abnormal MR signal within the spinal cord. After discussing the treatment options, it was decided to resect the tumour, with adjuvant preoperative embolization.

2.3. Embolization procedure

Due to location of the tumour in the posterior arch of T10, the tumour was considered amenable for percutaneous imaging-guided direct access. Given the proximity of the tumour to the spinal cord, intra-procedural neurological assessment was considered important, and thus the procedure was planned with local anesthesia and sedation, to allow for constant neurological assessment. Spinal angiography was considered, however was considered of little additional benefit due to tumour location in the posterior arch, and thus flow of the embolic agent through the tumour parenchyma retrograde into posterior arch feeding arterial vessels and then into spinal arterial vessels was considered unlikely if the direct tumour contrast parenchymogram did not reveal such vascular connections.

The patient was positioned prone on the biplanar angiography procedure table with full sterile preparation. Pre-procedure steroids (8 mg intravenous Dexamethasone) and antibiotic prophylaxis (600 mg Clindamycin) were administered. The tumour was localized using fluoroscopy and bony landmarks. A flat panel volume CT was also performed to confidently plan safe needle trajectory. Under fluoroscopic guidance an 18-gauge × 10 cm Chiba biopsy needle (Cook Medical, Bloomington, Indiana) was navigated directly into the tumour. (Fig. 2A) Satisfactory needle tip position was confirmed with repeat flat panel volume CT. The tumour parenchymogram did not reveal any collateral channels to spinal cord vasculature. (Fig. 2B) Only parenchymal tumour blush was observed with no opacification of spinal arteries or veins. The connection tubing and needle (which had been pre-tested to ensure compatability) were primed with dimethyl sulfoxide. A total of 1.4 ml of Onyx-34 was slowly injected into the tumour under continuous fluoroscopic guidance. In order to ensure filling of the posterior compartment of tumour, the needle was withdrawn slightly during the Onyx injection. Throughout the embolization, there was continuous lower limb neurological assessment. Post-injection flat panel volume CT confirmed satisfactory tumoural filling without non-target embolization. (Fig. 2C and D) Initial needle placement and tumour assessment was completed in 30 min; embolization time was 15 min.

2.4. Operation

Twenty-four hours after embolization, bilateral T9–T11 laminectomies were performed with en bloc resection of the tumour (Fig. 3) with no intra-operative complications. Estimated operative blood loss was 150 ml; operative time was 90 min.

2.5. Postoperative course

The patient recovered well post-operatively and was discharged home the day after surgery. His symptoms resolved, and he underwent further adjuvant radiotherapy. At 6-month follow up, the patient was pain free and well neurologically, however passed away due to systemic disease at 7 months after laminectomies.

3. Discussion

Our report demonstrates that percutaneous imaging-guided direct intra-tumoural embolization of selected spinal metastases is technically feasible, and can be performed under local anesthesia and sedation. This is an important report, since it may offer an alternate means of embolization for complex cancer patients with spinal metastases requiring surgery, at potentially lower risk than traditional embolization techniques.

There are only few reports of a direct intra-tumoural embolization technique for hypervascular spinal metastasis. Clarencon et al. reported a similar technique used for embolization of a C4 thyroid carcinoma metastasis in the posterior arch supplied by the left vertebral artery that also supplied the cervical anterior spinal artery under general anesthesia [10]. Using intermittent vertebral angiography, 5 ml of Onyx was injected into the tumour in a period of 15 min. After complete devascularisation, the tumour was removed en bloc, but the volume of operative blood loss was not reported. Most other reports of the direct intra-tumoural embolization technique have been used in combination with trans-arterial embolization, or with other liquid embolic agents, such as cyanoacrylates, and generally under general anesthesia [10–15]. Yao et al. reported direct intra-tumoural cyanoacrylate embolization under general anesthesia as an adjuctive treatment in spinal hemangiomas [13,14]. Two of the four patients were treated with only direct intra-tumoural injection of cyanoacrylate without prior spinal angiography. There were no complications using this technique.

Trans-arterial particle embolization is the most commonly reported method of pre-operative embolization of spinal RCC metastases. However, there remain limitations with this technique. While operative blood loss is significantly reduced by embolization [3,4], reports of mean blood loss remain significant, ranging between 300 and 8000 ml, and often greater than 1000 ml [2,3,8,9,16]. Trans-arterial embolization is often limited by vessel tortuosity, small arterial feeders, or local vasospasm during microcatheter access. RCC metastases often have irregular arterial feeders and dilated draining veins, making trans-arterial