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CERVICAL KYPHOPLASTY AND OSTEOCOOL™ RADIOFREQUENCY ABLATION FOR PAINFUL CERVICAL METASTASIS: A CASE REPORT AND NOVEL APPROACH FOR PAIN RELIEF

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Background: Metastatic bone pain is very difficult to treat and challenging to manage for health care professionals. Kyphoplasty or vertebroplasty has been used to reinstate the height of a compressed fractured vertebral body. OsteoCool™ radiofrequency ablation (RFA) is a relatively new ablation technique and at present, current literature only supports its role for thoracic and lumbar vertebral metastases.

Case Report: In the present case report, we utilized OsteoCool™ RFA using anterolateral cervical kyphoplasty for cervical spinal metastasis with intractable pain and limited range of motion.

Discussion: A successful palliative treatment was provided with a combination of kyphoplasty and OsteoCool™ RFA. The patient has had great relief of pain and an increased range of motion of the cervical spine post procedure.

Conclusion: Anterolateral balloon kyphoplasty provides stability to fractured vertebrae and when combined with OsteoCool™ RFA, it potentially can provide effective pain relief in patients who have failed radiation and for whom surgery is contraindicated.

Key words: Cervical kyphoplasty, cervical vertebral metastasis, kyphoplasty, OsteoCool™

BACKGROUND

Bone metastases occur in about two-thirds of cancer patients (1). Metastasis affects vertebrae, pelvic bone, femur, humerus, ribs, and skull. Breast cancer is the most prevalent cancer that metastasizes to vertebrae, followed by lungs, thyroid, kidney, and prostate cancer (2). Brihaye et al (3) evaluated 1477 patients with vertebral metastasis and reported that thoracic and thoracolumbar regions were involved in 70.3% of patients, and cervical and cervicothoracic regions were affected in 8.1% of patients. In about 50% of the patients, multiple levels are involved. Thirty-six percent of vertebral metastasis are asymptomatic and detected incidentally. Bony and/or radicular discomfort, weakness, numbness, and loss of urine and rectal control are symptoms of spinal metastases (4).

Restoring spinal stability, relieving pain, and decompressing neuronal tissues are the goals of spinal metastasis treatment. Radiation therapy is the first-line treatment for spinal metastases, however surgery is required in individuals with spinal instability or a radiation-resistant tumor (5). The cervical spine lies near

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key arterial systems and nerves, making surgery difficult. Anterior and posterior approaches are required (6).

Kyphoplasty or vertebroplasty has been used to reinstate the height of the compressed fractured vertebral body. A small balloon is introduced percutaneously through a big bore needle and the balloon is inflated in the vertebral body to generate a void within the cancellous bone. Bone cement is then utilized to fill the void. The use of radiofrequency ablation (RFA) of the targeted part of the vertebral body before filling up the part with bone cement has been proven to be beneficial in pain relief (7). Traditional RFA possesses risk of spinal cord injury from the high temperature generated by the electromagnetic field. The OsteoCool™ (Medtronic, Minneapolis, MN) RFA is relatively a new ablation technique, first approved in November 2015 and introduced into practice in early 2016. The OsteoCool™ ablation with kyphoplasty has thus far been used only for thoracic and lumbar vertebral metastasis (8). There have been a few recent studies that have shown promising results of anterolateral cervical kyphoplasty for cervical spine metastatic disease (8). There are no reported cases of OsteoCool™ RFA using anterolateral cervical kyphoplasty for cervical spinal lesions.

Our case study examines the effectiveness and safety of OsteoCool™ RFA for cervical spinal metastases with persistent pain and limited range of motion. Radiofrequency tumor ablation can relieve pain and offer spinal stability when paired with kyphoplasty.

CASE

A 57-year-old man with a history of stage IV small cell carcinoma of the lung with metastasis to the cervical spine was referred to the pain clinic for management of severe pain in the neck radiating to the left arm. He described the pain as sharp, 10 of 10 in intensity utilizing the visual analog scale (VAS). He had previously tried a fentanyl patch, hydrocodone, gabapentin, and diazepam without significant pain relief. Computed tomography (CT) scan of the cervical spine showed a prominent lytic lesion involving the left pedicle, lamina, and spinous process of C7 extending to T1. Magnetic resonance imaging of the cervical spine was completed to evaluate the cervical spine in detail and revealed a cervical spine metastatic mass extending from C5-T3, mostly located on the left side of the vertebral bodies with epidural spread and possible intrathecal spread. The plan was made to perform C7 kyphoplasty with possible OsteoCool™.

Potential risks, benefits, alternatives were explained to the patient, and informed consent was obtained. The patient was placed in a supine position. General anesthesia was initiated with a laryngeal mask airway. The anterolateral neck and midline were prepped and draped in sterile fashion. Preoperative antibiotics were administered. The C7 vertebrae was carefully localized using multiple anterolateral and lateral views on fluoroscopy, counting out from the dens as this is the C2 vertebral body and the uppermost thoracic rib over the corresponding T1. Under ultrasound and fluoroscopic guidance, a local anesthetic skin wheal was raised overlying the C7 vertebral body. Slowly, after the local anesthetic skin wheal was raised, the cannula was advanced in the direction of the C7 vertebral body using a right-to-left approach. Once bony contact was ensured, ultrasound was used to confirm that the carotid vasculature had been avoided. At that point, the cannula was tamped into the center point of the vertebral body in anterior and lateral fluoroscopic views. Thereafter, a hand-operated drill was used to extend across the left portion of the C7 vertebral body well within the confines of the vertebral body, and anterior to the spinal canal. Subsequently, the cannula was pulled back slightly to allow advancement of the OsteoCool™ 7-mm probe. The tip of the probe was kept on the left part of the C7 vertebral body without crossing the midline. Then, radiofrequency OsteoCool™ lesioning was initiated for approximately 6.5 minutes x 2 cycles, again using a 7-mm active tip. After the OsteoCool™ lesioning was done, a balloon was used to insufflate the predominantly left portion and the center portion of the C7 vertebral body to approximately one mm. This stayed well within the confines of the vertebral body. The bone cement was then admixed and approximately 0.75 mL of cement was delivered in the void created by the cannula. The needle was removed, and a bandage was applied. The patient was transferred to the recovery room.

The patient was followed up in the clinic one month and 2 months after the procedure. The patient's VAS pain score was reduced to 4 of 10 post procedure from 10 of 10. The patient was having severe limitations of neck rotation to the left and right before the procedure. It was limited to only 15 degrees preprocedure, which improved to 35% to 45% post procedure. No appreciable changes in flexion and extension were noted after the procedure (Figs. 1-5).

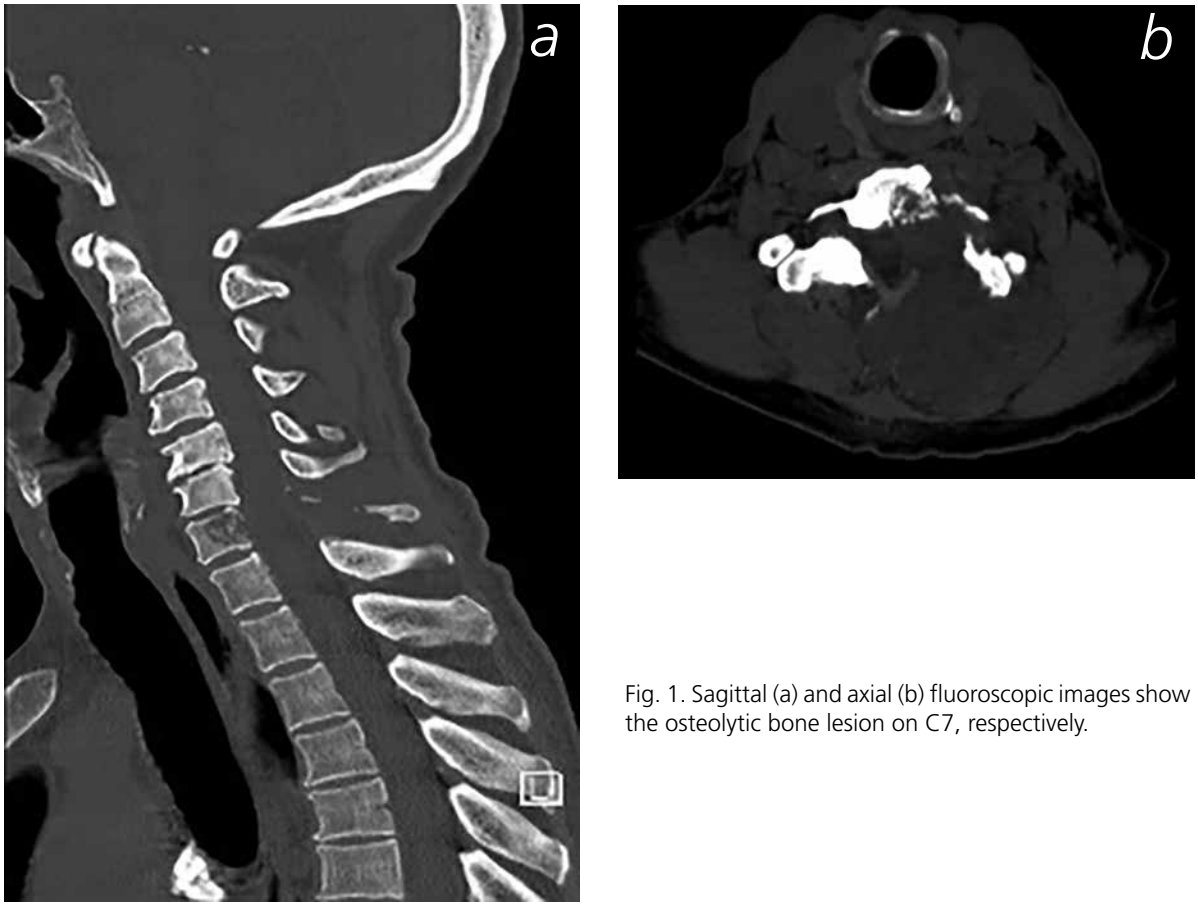

Fig. 1. Sagittal (a) and axial (b) fluoroscopic images show the osteolytic bone lesion on C7, respectively.

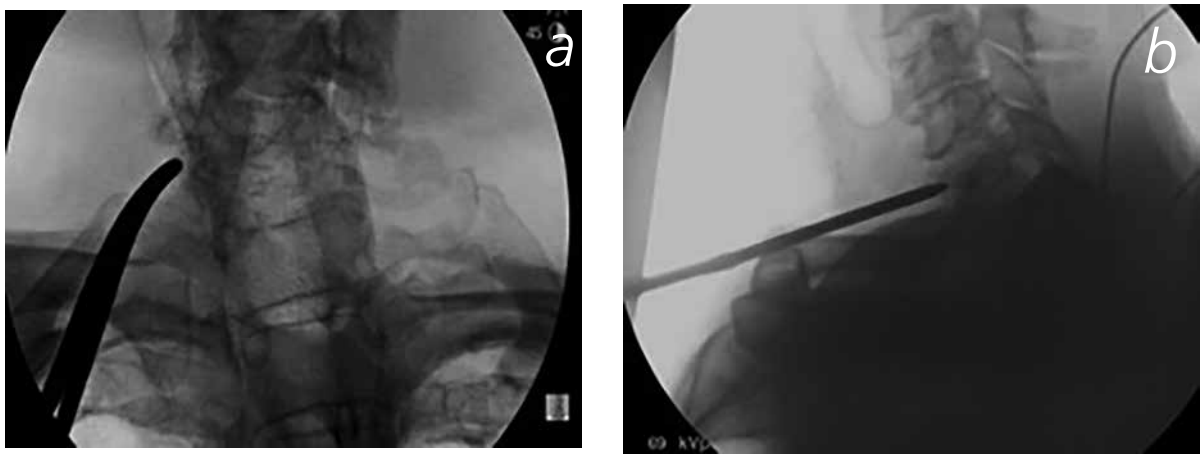

Fig. 2. Anteroposterior (a) and lateral (b) views showing the skin entry point at the level of C7 vertebrae, respectively

Discussion

The present case report demonstrates the efficacy, safety, and technical aspects of an anterior cervical kyphoplasty and OsteoCool™ in the management of painful cervical vertebral metastasis. Although metastasis in cervical vertebrae is rare, it is always painful. Pain in cervical vertebral metastasis is related to bone invasion, neural compression, and pathological fractures.

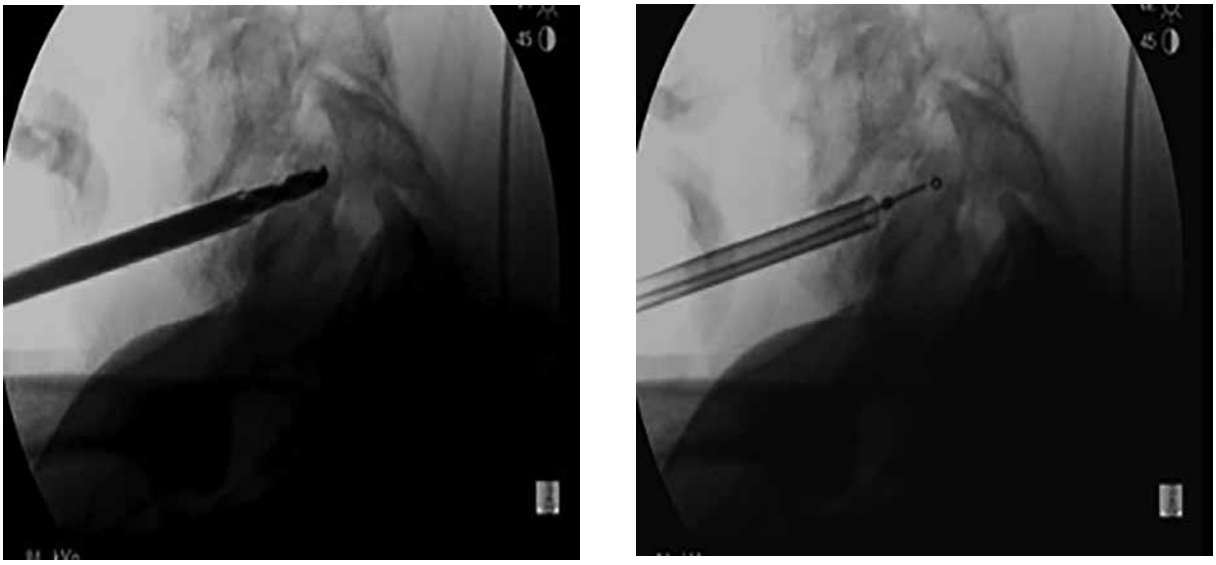

Fig. 3. Lateral fluoroscopic views of a hand-operated drill extended across the left portion of the C7 vertebral body well within the confines of the vertebral body, and anterior to the spinal canal.

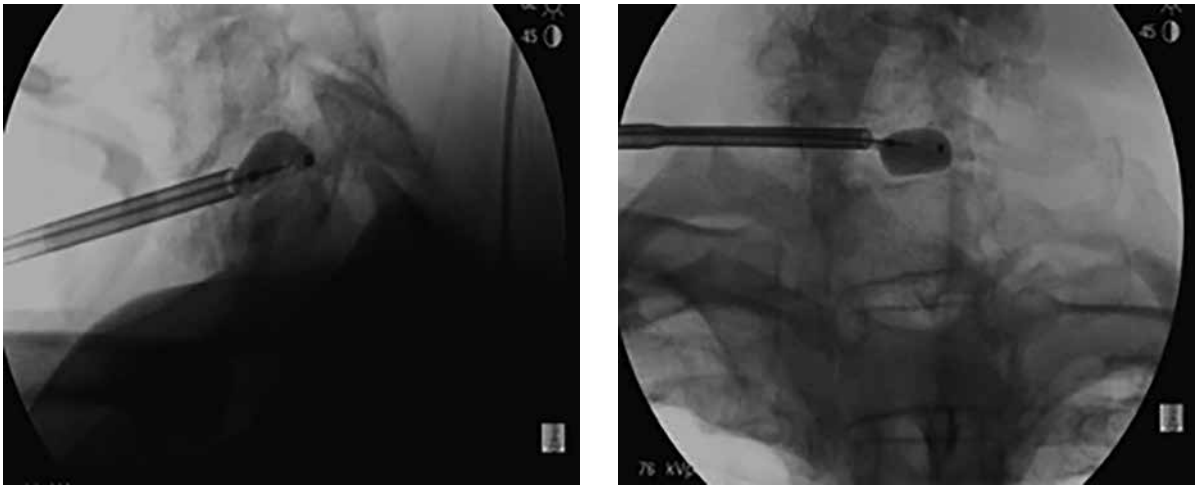

Fig. 4. Lateral and anteroposterior views of inflated balloon within the body of the C7 vertebrae.

Radiation therapy is the first-line palliative treatment for cervical vertebral metastasis. In radiation-resistant cases, surgical management with posterior decompression or anterior corpectomy can be performed. Complications of surgery include slow recovery, high rates of infections, and possible injury to the spinal cord. Minimally invasive vertebroplasty and kyphoplasty provide an alternative to surgery.

Another possible explanation for pain relief is the chemical and thermal neurolytic effects of the percutaneous polymethylmethacrylate (PMMA) (9). A placebo effect is also thought to play a role from the impact of the local anesthesia, as well as nonspecific effects such as higher expectation from the procedure (10).

OsteoCool™ RFA is a relatively new system that has been in practice since 2016. To date, there are only 2 case series studies published in Canada that mention the feasibility and safety of OsteoCool™. We used the Medtronic bipolar, coaxial OsteoCool™ RFA kit in our patient. The OsteoCool™ RFA provides a continuous temperature of 70°C over 7 to 15 minutes. The active tip of the probe is cooled by circulating water, which regulates the temperature close to the active tip of the probe. This safety mechanism provides the creation of

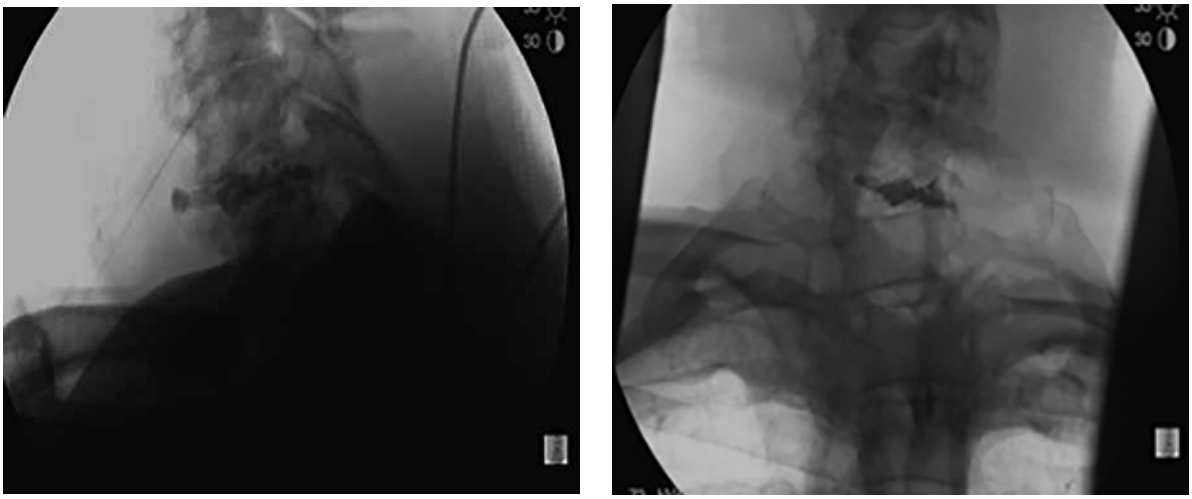

Fig. 5. Lateral and anteroposterior views of the cement within the body of C7 vertebrae.

large-volume lesions without heating the tip and thus it reduces the potential for heat injury to the surrounding tissue. The Medtronic brochure mentioned that OsteoCool™ RFA is contraindicated in C1-C7 vertebral bodies. There is a large clinical trial going on named "OsteoCool Tumor Ablation Post-Market Study," also named the "OPuS One" study, which also excluded patients with involvement of vertebral body levels C1-C7. In the present case report, we used OsteoCool™ in our patient since the patient was having excruciating pain for the last several months and had failed multiple medical management interventions. Also, he was not a surgical candidate provided his high tumor burden and overall poor performance status.

There are 3 approaches with which the cervical kyphoplasty can be performed: the transoral approach, transpedicular approach, and anterolateral approach. The transoral approach was described by Kaminesky et al (12) for C2 vertebral body lytic lesions. The advantage of this approach is that it can prevent damage to neurovascular structures. This approach requires the expertise of otorhinolaryngology. Further, its complications include higher infection rates, including pharyngeal infections and meningitis, injury to vertebral arteries, and cerebrospinal fistulas. The transoral approach is not useful for lower cervical vertebrae from C3-C7 (11-13). The transpedicular approach is also associated with the risk of vertebral arteries (13). Anterolateral cervical kyphoplasty is relatively safe if done by an experienced pain physician (14). The anterolateral approach is associated with the risks of asymptomatic cement leakage. This complication can be reduced by injecting a low volume (about 2-3 mL per vertebrae) under meticulous fluoroscopy control. Another complication of the anterolateral approach is that there is a chance of damage to the neurovascular structures, which can be reduced by isolating these structures with the use of an ultrasound probe.

CONCLUSION

Our case provides a better alternative palliative pain relief technique in patients with painful cervical metastasis. Anterolateral balloon kyphoplasty provides stability to the fractured vertebrae, and when it is combined with the OsteoCool™ RFA, it provides effective pain relief in patients who failed radiation and for whom surgery is not possible for any reason.

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