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COLD RADIOFREQUENCY ABLATION FOR VERTEBRAL BONE TUMORS: OSTEOCOOL, CASE REPORT AND LITERATURE REVIEW

**ABLACIÓN POR RADIOFRECUENCIA FRÍA PARA
TUMORES ÓSEOS VERTEBRALES: OSTEOCOOL,
REPORTE DE CASO Y REVISIÓN DE LA LITERATURA**

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Cold Radiofrequency Ablation for Vertebral Bone Tumors: OsteoCool, Case Report and Literature Review

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ABSTRACT

Background: The spine is the most frequently affected site in skeletal metastases, representing up to 70% of cases. These lesions can cause severe pain, fractures, and neurological deficits, significantly affecting quality of life. Conventional management includes opioids, bisphosphonates, surgery, and radiotherapy; however, these may be limited by delayed recovery, toxicity, or long-term side effects. **Case presentation:** We describe the case of a 38-year-old male with a vertebral lesion at T6, suggestive of metastasis, who underwent percutaneous cold radiofrequency ablation using the OsteoCool system combined with kyphoplasty. The procedure was completed without complications, achieving immediate pain relief and early mobilization, allowing hospital discharge within 24 hours. **Discussion:** Cold radiofrequency ablation offers a safe, minimally invasive alternative for the treatment of vertebral bone tumors, providing rapid pain control, reduced opioid use, and early initiation of adjuvant therapies. **Conclusion:** In selected patients, OsteoCool radiofrequency ablation can improve prognosis and quality of life, representing an effective option in both palliative and curative settings.

Keywords: cold radiofrequency, bone tumors, benign tumors, metastases, spinal cord

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Ablación por Radiofrecuencia Fría para Tumores Óseos Vertebrales: Osteocool, Reporte de Caso y Revisión de la Literatura

RESUMEN

Introducción: La columna vertebral es el sitio más frecuentemente afectado en las metástasis óseas, representando hasta el 70% de los casos. Estas lesiones pueden provocar dolor intenso, fracturas y déficit neurológico, con un impacto significativo en la calidad de vida. El tratamiento convencional incluye opioides, bifosfonatos, cirugía y radioterapia; sin embargo, estas opciones pueden verse limitadas por tiempos prolongados de recuperación, toxicidad o efectos adversos a largo plazo.

Presentación del caso: Se describe el caso de un paciente masculino de 38 años con lesión vertebral en T6, sugestiva de metástasis, tratado mediante ablación percutánea por radiofrecuencia fría con el sistema OsteoCool, complementada con cifoplastia. El procedimiento se realizó sin complicaciones, logrando alivio inmediato del dolor y movilización temprana, con egreso hospitalario a las 24 horas.

Discusión: La ablación por radiofrecuencia fría constituye una alternativa segura y mínimamente invasiva para el manejo de tumores óseos vertebrales, con control rápido del dolor, menor uso de opioides e inicio temprano de terapias adyuvantes. **Conclusión:** En pacientes seleccionados, la ablación por radiofrecuencia con OsteoCool puede mejorar el pronóstico y la calidad de vida, siendo una opción eficaz en contextos paliativos y curativos.

Palabras clave: radiofrecuencia fría, tumores óseos, tumores benignos, metástasis, médula espinal

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INTRODUCTION

After the lung and liver, the skeletal system is the third most common location of metastases and one of the most affected segments is the spine where around 70% of all bone metastases are located, and these can be single or multiple. When this condition exists, the morbidity and quality of life of the patients is severely affected. (1) Although they are often asymptomatic, metastases are an important cause of morbidity and mortality and can reduce quality of life, around 80% of patients experience intense pain before establishing the diagnosis. (2) An example of this pathology is represented by osteoma. osteoid, which in a benign bone tumor which typically affects the long bones of the lower limbs, can be asymptomatic or present as nocturnal pain that subsides with the ingestion of common analgesics. (3)

Metastatic bone tumors represent 60 to 84% of cases and can manifest as pain, fracture or neurological focalization. The goals of treatment are to make the diagnosis, decrease pain, reduce late neurological focus, preserve function, and improve quality of life. (4) Pain associated with bone metastases may be due to neural compression, pathological fractures, or biological mechanisms such as cytokine production by the tumor, stimulation of nociceptors by elongation of the periosteum, or production of nociceptors by leukocytes (5). Often the improvement in pain is not immediate, it may take 4 to 6 weeks to be effective. The multimodal treatment approach consists of opioids, bisphosphonates, surgical fixation and radiotherapy, however, they may be ineffective due to long recovery times after surgery, tissue toxicity associated with radiotherapy and tolerance with increased side effects. of long-term opioid use. (6)

Radiosurgery has demonstrated higher rates of palliation of 50 to 85%, but is associated with fracture rates of 11 to 39%. Invasive surgical treatments such as vertebroplasty, placement of transpedicular screws and vertebrectomy, considered invasive, help reduce pain and avoid deformation; however, they represent a longer recovery time, a higher rate of infection and therefore greater morbidity and mortality, and they can also delay the start of adjuvant treatments such as radiotherapy or systemic therapies. Currently there are several types of minimally invasive treatments such as the use of analgesics such as bisphosphonates, radiotherapy, cryotherapy and radiofrequency. (7)



Since 2014, research protocols began for the use of new techniques in the treatment of metastatic vertebral lesions (cold radiofrequency ablation) in animal models (8). Last 2017, a prospective study began with the purpose of evaluating the effectiveness of Medtronic's OsteoCool radiofrequency ablation system for reducing pain in bone metastases of thoracic and lumbar vertebrae. (9)

The OPuS One study was a prospective, multicenter, global investigation carried out to assess pain and quality of life prior to radiofrequency ablation and its follow-up up to 12 months afterwards using the Brief Pain Inventory (BPI) tool and the EQ index. (10), for the same purpose the European Organization for Research and Treatment of Cancer Quality of Life (EORTC QLQ-C15-PAL) has also been used. (11) Minimally invasive percutaneous radiofrequency ablation procedures have shown improvement in pain, with prompt recovery, as well as a decrease in the use of opioids.

The objective of radiofrequency ablation is mainly improvement in pain within the first 3 days and sustained for up to 12 months, this improvement being confirmed by assessing the worst pain, intermediate pain and its interference with quality of life. (12) The use of radiofrequency ablation with OsteoCool compared to performing Kyphoplasty does not show significant differences in terms of pain reduction and the use of opioids for this purpose. (13) The OsteoCool generator produces 40 W of power (20 W of power per channel), allowing the tip of the scope probe to maintain temperatures of 70 degrees, for a set period of time, allowing the energy to pass to the surrounding tissue and cause necrosis due to coagulation, and the probe is capable of measuring the temperature of the surrounding tissue to monitor critical areas such as proximity to nerve roots. (14)

MATERIALS AND METHODS

Electronic clinical record of the patient, Literature and background available in previous publications, human and financial resources of the Naval Medical Center.

A review of the clinical case was carried out as well as the literature available in PubMed related to it.

Indications for Osteocool

Treatment of benign bone tumors where the purpose is curative, for example in osteoid osteomas, and the second indication is the treatment of metastatic tumors, where the objective is palliative and is limited by the size of the lesion.



Osteocool Contraindications

Distance of less than 1 cm between the lesion and the spinal cord, lesions that affect the posterior wall of the vertebral body, and lesions that cause cortical destruction with involvement of surrounding soft tissue, the ones that are considered for this treatment must fulfill this conditions.

Case Presentation

38-year-old male, active duty military member of the Mexican Navy, history of being a keyboardist. His current condition began approximately 4 months prior to his evaluation in the Neurosurgery service when he presented sudden onset pain referred to the right scapula. He went to the emergency service on several occasions referring pain diagnosed as mechanical lower back pain, due to the persisting pain, he was sent to the traumatology and orthopedics service. Magnetic resonance imaging was requested, the T2 weighted image highlighted an area of hyperintensity at the vertebral body of T6 (Figure 1), for which he was referred to the neurosurgery service. Upon arrival, the neurological examination showed strength 5/5 in the thoracic and pelvic limbs, corresponding chest pain at level T6 and T7, and the perception of fine and coarse touch without abnormalities. A nuclear magnetic resonance imaging study was evaluated, T2 sequence highlighted a space occupying lesion at T6 vertebral body and facets, suggestive of a neoplastic lesion (Figure 2).

Taking into account the characteristics of the lesion, the patient and the procedure criteria, he was considered as a candidate to receive a magnetic ablation system, cold radiofrequency therapy (OsteoCool).

The procedure was explained in detail to the patient and informed consent was obtained. Prior to the procedure, adequate ultra-short antibiotic prophylaxis was administered, after asepsis and antisepsis of the dorsal region to be intervened, lidocaine was infiltrated with 2% epinephrine, posteriorly an OsteoCool cannula was introduced and a second cannula was introduced. A biopsy of the lesion was taken for histopathological examination, a second electrode was introduced for radiofrequency, number 20, with parameters of 70° Celsius and 9.0 Watts for 15 minutes without incidents (Figure 3), a cannula for kyphoplasty was inserted with 6 cc of bone cement under fluoroscopy corroborating adequate placement ending the procedure.



In the recovery area the patient was asymptomatic, adequately mobilizing 4 limbs, being discharged from the hospitalization service 24 hours after the procedure, with painless gait or any abnormalities during the physical and neurological examination.

Figure 1. Magnetic Resonance Imaging T2 of the thoracic spine, sagittal showed an area of hyperintensity in the vertebral body of T6 suggestive of a neoplastic process.



Figure 2. Magnetic Resonance Imaging T2 of the thoracic spine, axial showed an area of hyperintensity in the vertebral body of T6 suggestive of a neoplastic process.

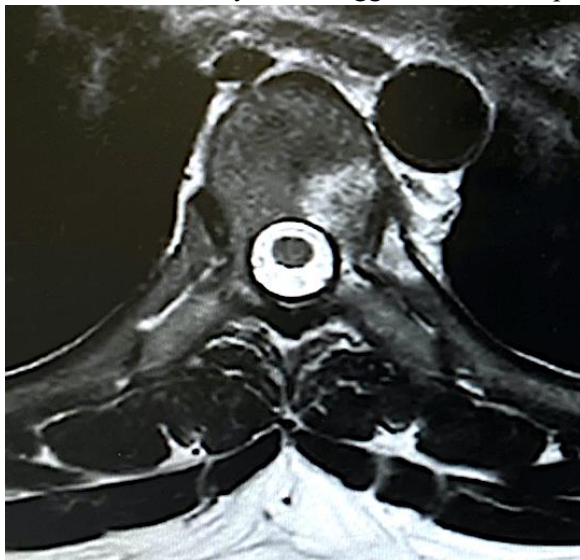


Figure 3. Graphic record of temperature, time and radiofrequency power of the OsteoCool system, reaching a maximum temperature of 71° Celsius and 9.8 W during the radiofrequency.



DISCUSSION

The third most common location of bone metastases corresponds to bone tissue, in turn one of the most frequently affected sites corresponds to the spine. The cold radiofrequency ablation technique represents one of the most innovative treatment modalities that it offers to patients, who are subjected to it, a prompt decrease in pain, better rates of recovery and return to daily activities, as it is a new technique, there is little information published in relation to it, in the present case the patient showed a significant clinical improvement which agrees with previously published information, this fulfills its primary objective, which places it as a treatment modality option for those patients who meet the criteria to undergo radiofrequency ablation.

CONCLUSIONS

Patients with vertebral bone metastases or benign bone tumors often face significant limitations in mobility, persistent pain, and a marked deterioration in quality of life, in addition to the high consumption of medical, human, and economic resources required for their care. In this context, the OsteoCool cold radiofrequency ablation system emerges as a valuable therapeutic alternative, capable of offering rapid pain relief, minimal invasiveness, and early return to daily activities. Its ability to allow the prompt initiation of complementary treatments, such as radiotherapy or systemic therapy, makes it particularly advantageous in palliative settings, where every day of functional preservation counts.

The present case illustrates not only the technical feasibility of the procedure but also its clinical benefit, with immediate improvement in symptoms and early hospital discharge. These results are consistent with existing literature, reinforcing the role of cold radiofrequency ablation as an effective and safe option for carefully selected patients. Although further prospective studies with larger cohorts are needed to establish long-term oncological outcomes, current evidence supports its inclusion as part of the multidisciplinary management of vertebral bone lesions, whether with curative or palliative intent.

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Conflict of Interest

No conflict of interest to disclose.

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