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Role of Image Guided Thermal Ablation in the Management of Painful Metastatic Bone Tumors

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Abstract---Background: Variable palliative options are now made available for patients suffering metastatic bone deposits, which in turn can be very painful, debilitating and crippling, let alone their negative impact on daily life activities, undermining the whole quality of life for affected individuals. With the wide range of available treatment options, comes wide possible drawbacks for each type of treatment. In our study we aim at assessing the safety and efficacy of thermal ablation guided by imaging tools to treat painful bony metastasis and hopefully providing better overall quality of life. Patients and methods: 12 patients underwent thermal ablation, 10 underwent RF ablation and 2 underwent microwave ablation, follow up was done at baseline, at 24 hours, 1, 2 and weeks as well as 1, 2 and months post-treatment. Pain scores were calculated at each point and compared in correlation to the treatment received. Results: At baseline, mean pain scores were around 9. At 3rd month post-treatment follow up the median value became 2, with a significant p value of about 0.003. Conclusion: radiofrequency/microwave ablation

have statistically significant effect in pain reduction hence, quality of life in treatment of patients with metastatic bone tumors.

Keywords---bone metastases, microwave ablation (MWA), minimally invasive treatment, pain, radiofrequency ablation (RFA).

Introduction

The most common cause of significant pain in cancer patients is skeletal metastases. Bone pain has a significant impact on a patient's quality of life. It might result from periosteal stretching as a result of tumor growth, as well as the release of tumoral cells' chemical mediators, osteolysis, micro- and macro fractures, and spinal compression fractures, entrapment, and nerve root infiltration causing bone deterioration (1). Irradiation therapy has been shown to be useful in the treatment of pain. External irradiation therapy, on the other hand, does not work for roughly 20–30% of individuals with painful metastatic bone cancers. Furthermore, according to reports, the recurrence rate of pain after external irradiation therapy is 27%, and subsequent irradiation is problematic due to dose restrictions for normal structures (2). Radiofrequency ablation (RFA) involves passing a high-frequency alternating current through the surrounding tissue through a needle electrode, causing frictional overheating and cytotoxicity (3). Microwave energy radiates into the tissue through an interstitial antenna couples energy from generator power supply to the tissue. The thermal radiation emitted by the antenna causes direct heating in the nearby tissue volume, resulting in tumor necrosis (1).

Patients and Methods

Patients' selection

This study was approved by the institutional review board at Ain Shams University. 12 patients were selected to participate in our study from 2018 till 2021. They were recruited from oncology and orthopedic out-patient clinics using a convenient sampling method. Diagnosis of metastatic bone deposits was confirmed histologically, and further radiological assessment was performed. All patients were 18 years old or older and were prescribed for either RF or microwave thermal ablation for treatment of painful bone metastasis. However, Patients with bearable pain, widespread painful metastatic bony lesions (more than 3), or with sclerotic metastatic bone lesions were excluded from our study.

During the ablation sessions, patients were either put in prone positions or supine position. We used RF ablation in 10 patients and microwave ablation in 2 patients. We used cluster electrode in one patient and single electrode in the rest of the patients. The active tips of the electrodes were ranging from 3 cm to 4 cm with mean value about 3.14 cm. We used CT guidance alone in 11 patients and used combined CT and ultrasound guidance in 1 patient. The number in ablation sessions ranged from one session to two sessions. The average session duration was 9 to 24 minutes with mean value of about 14.36 minutes.

Results

Between July 2018 until December 2021, 12 consecutive patients diagnosed with in-operable cancer with bony metastasis were enrolled in our study for assessment of the safety and efficacy of thermal ablation guided by imaging tools in reducing pain sensation. Of these 12 patients, there were (16.67%) females and (83.33%) males, of mean age 57.85 ± 8.79 . Regarding the primary tumors; 5 patients were diagnosed with bronchogenic carcinoma, 4 with HCC, 1 with pancreatic adenocarcinoma, 1 with rectal carcinoma and 1 with breast carcinoma. Baseline median pain score value was 9. From the first week to three month follow up there was significant gradual reduction of the pain score with reduction of the median value form 6 in the 1st week down to 2 by the end of the 3rd month with a highly significant p value (0.002).

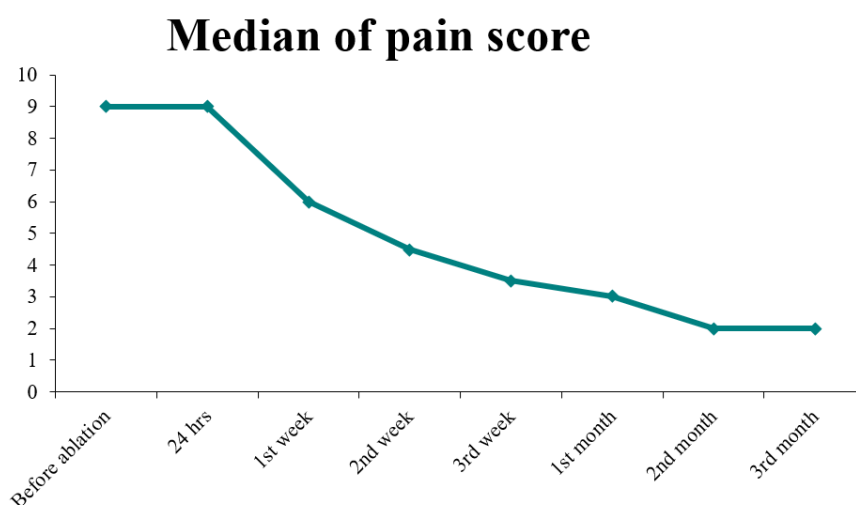


Figure 1. Showing the significant reduction of pain scores at baseline, and over 3 months follow up.

As regards the need for analgesic intake, the opioid dose prior to ablation ranged between 50 to 200 with significant gradual reduction with median value 75 reaching to total withdrawal at 1st month.

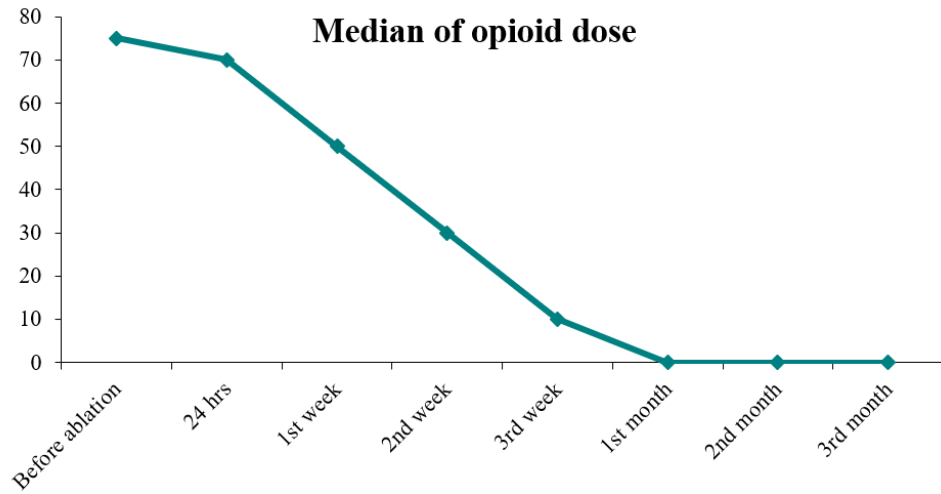


Figure 2. Showing the significant drop in analgesic intake over three months following treatment.

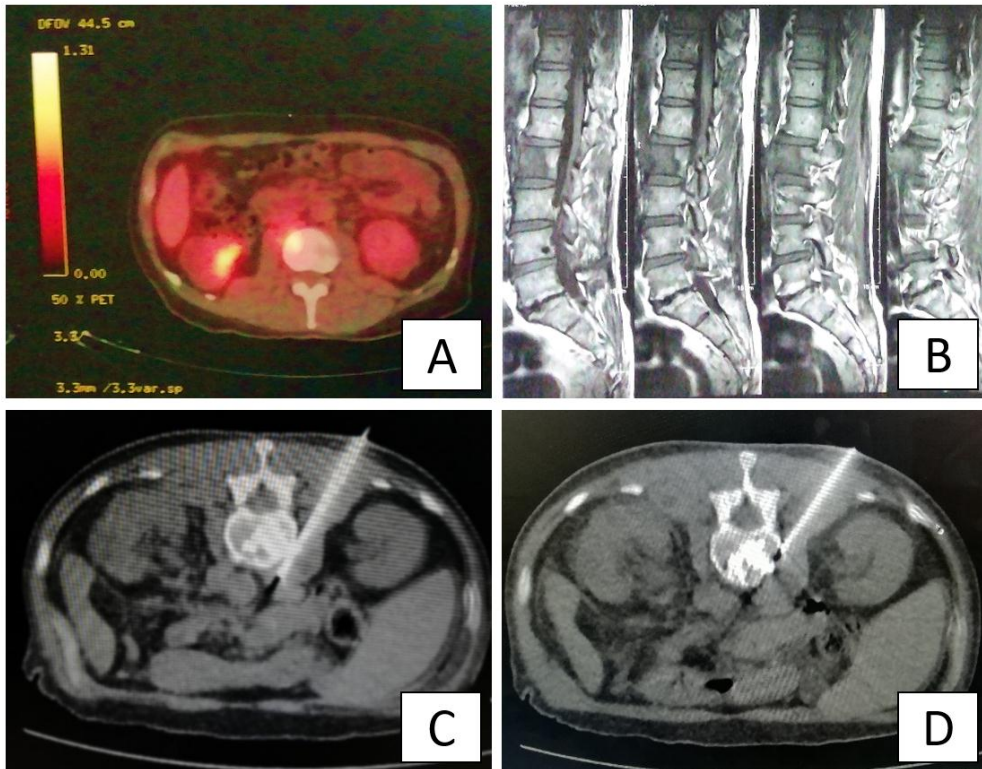


Figure 3. A 57-year-old male patient with pancreatic adenocarcinoma, the patient was complaining of severe back pain

The PET-CT and MRI revealed paravertebral soft tissue mass invading the adjacent L2 vertebral (A and B), The patient previously underwent vertebroplasty for L2 vertebral body with no improvement of the pain. We did radiofrequency ablation for this para-vertebral soft tissue lesion for pain palliation (C and D), The patient experienced improvement of the pain over the 3 months after the ablation with gradual decreased need for opioid analgesics.

Discussion

The pain caused by bone metastases might be difficult to manage. NSAIDs, opioids, radiation therapy, chemotherapy, hormone therapy, radiopharmaceutical therapy, imaging guided percutaneous ablation, surgery, and vertebroplasty are among the treatment options available. The term "ablation" refers to the local destruction of a tumor using either chemical agents (ethanol, acetic acid) or a local application of energy (radiofrequency, laser, microwave, ultrasound and cryoablation) (4). Callstrom et al. (2005) found that percutaneous ablation is an effective and safe therapy option for pain palliation in individuals with osteolytic metastases after treating 12 patients (5). Microwaves may permeate deeper, be less influenced by tissue heating or desiccation, and be more effective for heating bone tumors than RF energy due to bone's low conductivity and relative permittivity of RF (6). We saw an improvement in life quality and a considerable reduction in the usage of analgesic drugs in our patients, which has been reported in prior studies (7).

Conclusion

Radiofrequency / microwave ablation have statistically significant effect in pain reduction hence, quality of life in treatment of patients with metastatic bone tumors.

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