ORIGINAL ARTICLE

MICROWAVE ABLATION OF OSTEOID OSTEOMAS: OUR PRELIMINARY EXPERIENCE

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ABSTRACT

BACKGROUND: Image-guided percutaneous microwave ablation is a minimally invasive procedure to treat osteoid osteomas(OOs) but has not been thoroughly evaluated in Pakistan and few pilot studies have been published in the world literature. **PURPOSE:** The purpose of this study is to evaluate efficacy and safety of CT guided microwave ablation (MWA) of osteoid osteomas(OOs). **MATERIALS AND METHODS:** This retrospective study included four consecutive patients with computed tomographic (CT) diagnosis of OOs treated by CT guided MWA from January 2017 to December 2018. Under general anesthesia and CT guidance MWA of OOs done. DATA i.e. age, gender of patients, severity of pre-procedural pain, site and nidus size, procedure time and post procedural pain resolution were assessed. Pain resolution was clinically assessed by using visual analog score (VAS) on 1st day, 15 days and one month after ablation and any need for re ablation. Safety was assessed based on complication rate i.e. hematoma, burns or infection. **RESULTS:** All procedures were technically successful and the success rate was up to 100% (5/5). One case was a previously failed Radiofrequency ablation of OOs which was followed by MWA and that was successful. Minor complications were observed and no major complication seen. **CONCLUSION:** MWA is a very simple, successful, minimally invasive and curative treatment for OOs without any major complications. It can be a very useful and safe tool in the management of osteoid osteoma.

Keywords: Microwave ablation, osteoid osteoma.

Background

Osteoid osteomas (OOs) are usually found in children and young adults, between the ages of 7 and 25 years.[1] It is the third most common benign neoplasm of bone and accounts for 10-12% of all benign bone lesions with a male predilection (sex ratio male/female = 2). These are small tumors (usually <1.5 cm in diameter) having minimal or no growth rate.[2] On histology these are composed of a small hypervascular central nidus, surrounded by a purely reactive sclerosis.[3] It has a special predilection for the femur and tibia. Patients presents with nocturnal pain and have relief of their pain with anti-inflammatory agents such as aspirin.[3]

For the diagnosis and differential diagnosis of lesions with atypical findings and localizations, radiography, computed tomography (CT), bone scintigraphy, and magnetic resonance imaging (MRI) can be used. Osteoid osteoma is classically characterized at conventional radiography as a well defined lytic area which represents the vascularized central nidus, sur-

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rounded by sclerosis and cortical thickening. Computed tomography is an excellent imaging method to identify the central nidus of the tumor and can also be utilized for treatment, as a guidance for percutaneous removal of the nidus.[4] MR imaging depicts not only the nidus and accompanying sclerosis but also adjacent bone marrow and articular abnormalities. The nidus has low to intermediate signal intensity on T1-weighted images and variable signal intensity on T2-weighted images, depending on the amount of mineralization present in the center of the nidus. Edema in adjacent bone marrow and soft tissue and joint effusion also may be seen.[1]

Osteoid osteoma can be treated with various conservative and surgical methods, but these have some risks and difficulties. Surgical therapy was standard therapy few decades ago and was aimed at resection or damage of the nidus. The surgical treatment consists of en bloc excision or curettage of the lesion.[2,5] However there were complications such as fractures due to too large a volume of bone resection.[2] Today minimally invasive procedures are widely available, safe, and effective for treatment of neoplasms. Recently developed advanced methods, such as percutaneous CT-guided nidus drill radiofrequency ablation (RFA) or thermo-coagulation with a laser can also be used.[2,5,6] These advanced methods can be done in the radiology unit, but require specialized surgical equipment and are expensive.[5] These procedures are safe and effective, although recurrence rate after RFA has been reported to be from 5 to 10%.[7,8] Recently CT- guided microwave ablation (MWA) of osteoid osteoma has been introduced. It has specific advantages over RFA, such as it produces fast and well distributed heat in a tissue of a certain radius and has lower sensitivity to variations in tissue composition and bone impedance so that MWA produces higher temperatures within the lesion quickly. In bone tumors treatment, MWA has the advantage of penetrating deeper and being more effective then RFA, due to the bones low conductivity and relative permeativitiy.[2]

The primary objective of this study is to evaluate efficacy and safety of CT guided microwave ablation of osteoid osteomas. To our knowledge no local study of MWA of osteoid osteoma is available as it is a new technique and requires much research.

Material and Methods

This is an observational, retrospective study conducted in the department of Radiology Rehman Medical Institute Peshawar. It included four consecutive patients with computed tomographic (CT) diagnosis of osteoid osteoma treated by CT guided MWA from January 2017 to December 2018. Patients referred to the department with osteoid osteoma diagnosed on computed tomography were included in study. As exclusion criteria, the following was proposed: Patients with spinal osteoid osteoma, pregnancy, patients with pacemakers or other implanted electromagnetic devices and any contraindication to percutaneous thermo-ablation such as coagulation disorders.

Patients have been explained all the different management alternatives available and MWA has been proposed with its potential and respective risks. A total of 05 patients with osteoid osteomas diagnosed on CT were included. The patients accepted the treatment offered and signed informed consent forms. Local injection of 10 ml of 1% lignocaine and 1 gram IV augmentin given. Under general anesthesia (GA) by anesthetic team CT guided access to the lesion done via bone drill. Biomedics medical system microwave ablation round tip needle (Bone) was inserted in the central portion of the nidus of osteoid osteoma. The procedure occurred under CT guidance in such a way that it allowed the guided introduction of the probe verifying the exact location of the tip of the antenna and its orientation toward the center of the nidus of osteoid osteoma. Energy was applied for 3 min with 40 W of power. Incision closed with prolene suture. Patients monitored until full recovery from GA. Two doses of antibiotics (1 gm IV Augmentin) given and then oral Augmentin to complete a course for 5 days. Regular Diclofenic and Paracetamol started for 24-48 hours. Tramal was given in case of break through pain while in patient. Patients were allowed to mobilize as soon as they were able to.

DATA i.e. age, gender of patients, severity of pre-procedural pain, site and nidus size, procedure time and post procedural pain resolution were assessed. Pain resolution was clinically assessed by using visual analog score (VAS. Fig no. 1) on 1st day, 15 days and one month after ablation and any need for reablation.

Safety was assessed based on complication rate i.e. hematoma, burns or infection.

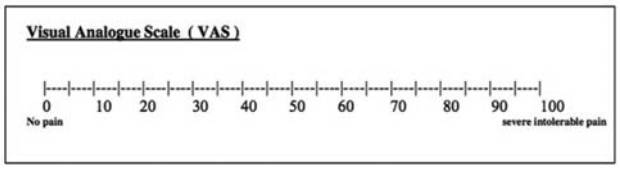


Figure 1: The visual analogue scale (VAS) used for evaluating the perceived pain among patients.

Results

A total of five consecutive patients with CT diagnosis of OOs treated by CT guided MWA from January 2017 to December 2018 were studied. All procedures were technically successful and the success rate was up to 100% (4/4). One case was a previously failed Radiofrequency ablation of OOs which was followed by MWA and that was successful.

The patients data i.e. age and sex of patients, duration of pain before procedure, location of osteoid osteoma, size of the nidus, post-procedure complications, pain VAS at one day, at seven days and one month after the procedure. Clinical results and summary of patients with osteoid osteomas treated with CT guided MWA is shown in (Tab.1).

S. No.	Age & Sex	Duration (months) and pain VAS before procedure	Location of OO	Size (mm) of OO	Post procedure compli-cations	Pain VAS one month post procedure
1	19yrs/ male	6months/ VAS severe pain	Left femur lesser trochanter	12mm	None	VAS No pain
2	18yrs/ male	4 months/ VAS severe pain	Right anterior acetabular cortex	13mm	None	VAS No pain
3	24yrs/ male	3months/ VAS severe pain	Left tibial shaft	10mm	First degree superficial skin burns	VAS No pain
4	18yrs/ male	6months/ VAS severe pain	Left femoral shaft	12mm	None	VAS No pain
5	26yrs/ male	4 months/ VAS severe pain	Right femoral shaft	12mm	None	VAS No pain

Table 1: Clinical summary of patients with osteoid osteoma treated with MWA.

In our study all patients were male and age range was from 18 to 26 years (mean= 21.75 years). Severity of pre procedural pain was assessed in all patients by using VAS and all five patient experienced severe pain. The follow up period varied from 4 months in two patients and up to 01 year in three patients. In the post procedural and follow up period, we achieved complete pain relief in all patients on the VAS one month after the procedure.

In our experience with the use of MWA for treatment of osteoid osteomas, the success rate was 100%. Only one minor complication of first degree superficial skin burn observed. However, the said burn healed well and there was a satisfactory outcome. No major complication seen.

Discussion

The application of microwaves in medicine has been largely in the field of external heat therapy mainly for the treatment of oncological diseases.[9] Other areas of interest have emerged and use of MWA in treatment of osteoid osteoma has been recently introduced.[2]

The term ablation refers to the direct application of thermal therapies to a specific tissue in an attempt to achieve substantial tissue destruction.[9] In our study, the thermal ablation technique consists of a microwave generator that emits an electromagnetic wave into the targeted area. Through a percutaneous incision, we access to the osteoid osteoma through CT guidance which can determine the exact location of the nidus. Electromagnetic microwaves produce friction and heat and this process induces cell death through coagulation necrosis and destroys the nidus.

The goal of MWA is to completely destroy the entire nidus of osteoid asteoma and achieve complete pain relief. In one of our study cases of left femoral cortical osteoid osteoma (Fig.2) which after microwave ablation under CT guidance (Fig.3) showed sclerosis of OO nidus on one month post procedure X Ray (Fig.4) and complete pain relief on VAS. In all of our five study cases we achieved complete pain relief on VAS and this is comparable with the pilot study of Prud, Home etal.

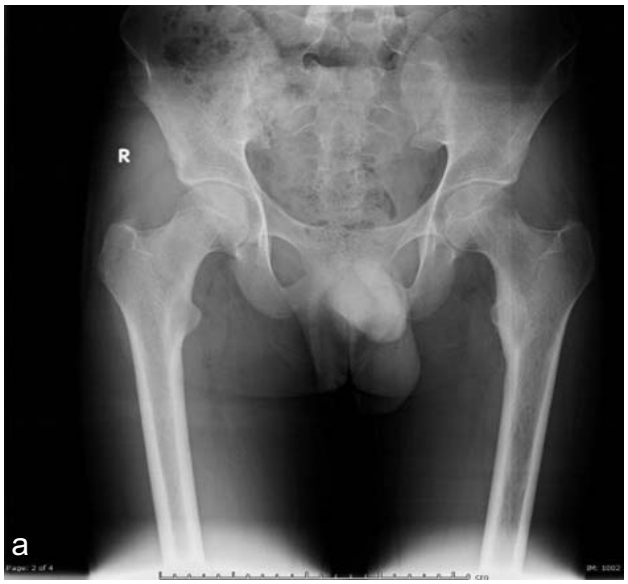
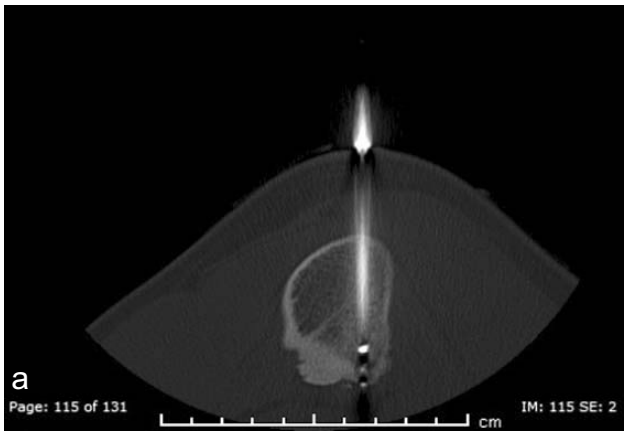


Figure 2(a,b): X Ray and CT-scan showing intracortical osteoid osteoma in left proximal femoral shaft. Lucent nidus with central calcification seen.



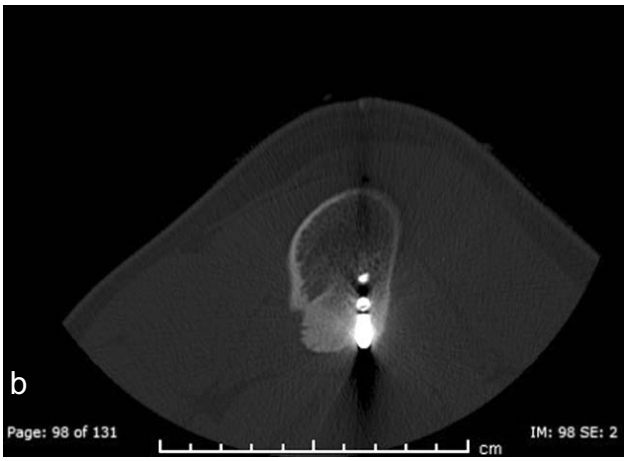


Figure 3(a,b): End of MWA guide-wire passed inside the nidus under CT guidance, through which microwaves are introduced.

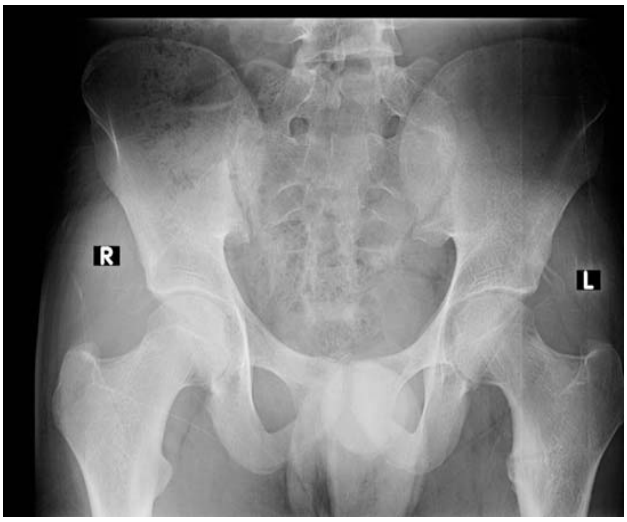


Figure 4: Post MWA X- ray of left proximal femoral osteoid osteoma showing sclerosis of the nidus.

We obtained good results and complications of a lower order. Only in one case of left tibial shaft OO (Fig.5) after MWA (Fig.6) had first degree superficial burns which healed completely within few days. In an 18 year old patient with right anterior acetabular OO the MWA procedure was technically difficult but was successfully performed without any complication (Fig.7) Compared with traditional techniques, local thermal ablations and regional image guided treatments offer an advantage with respect to reducing morbidity and mortality. This advantage is at a lower cost compared with the traditional surgical procedures.[10]

Figure 5(a,b): X Ray and CT-scan showing intracortical osteoid osteoma in tibial shaft.

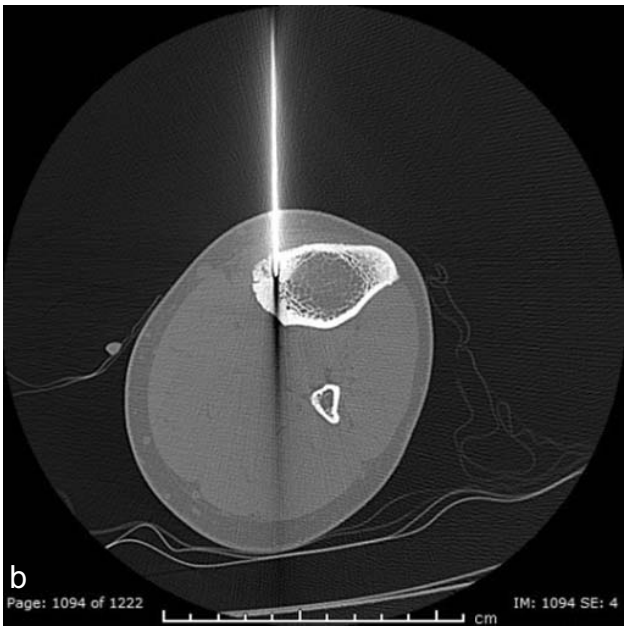


Figure 6(a,b): Axial CT images bone window showing MWA guide-wire introduced inside the nidus in cortex of tibial shaft.

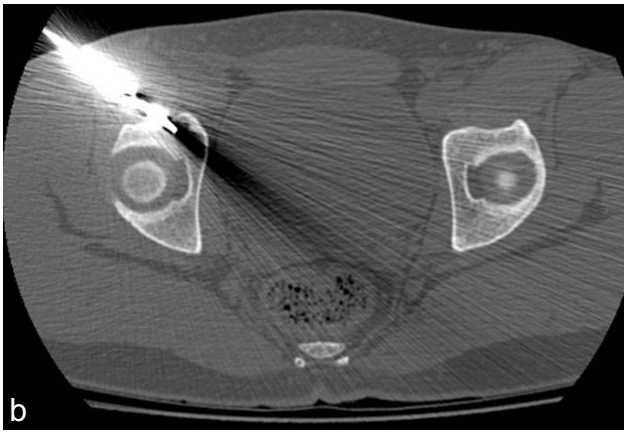


Figure 7(a): CT-scan. Osteoid osteoma in right anterior acetabulum. We see the nidus with central calcification and skin marker for CT guidence. **(b)** MWA guide wire passed into the osteoid osteoma nidus.

Conclusion

CT-guided MWA of osteoid osteomasturns out to be, in our humble experience, a minimally invasive, safe, and useful technique for the treatment. Although they are very few preliminary cases but in our experience, with respect to the management of osteoid osteoma MWA is a useful tool and is more effective as compared to RFA.

Undertaking: This is an original research and i have not published it earlier.

Conflict of Interest: None

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