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ORIGINAL ARTICLE Bone & Soft Tissue Tumors

Role of percutaneous computed tomography-guided radiofrequency ablation in treatment of osteoid osteoma

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Abstract

Aim: The aim of the study was to evaluate efficacy of percutaneous computed tomography (CT)-guided radiofrequency ablation (RFA) of nidus in osteoid osteoma (OO). **Materials and Methods:** RFA was performed on fifty patients with clinically and radiologically diagnosed OO. RFA was done in the department of radio-diagnosis in our institute (a tertiary care providing institute in Ahmedabad, Western India). Ablation was performed by putting at an electrode tip (3–5 mm) into nidus under CT guidance with targeted temperature of 90°C for 3 min. **Results:** All procedures were technically successful. No immediate major or minor complications were observed. Complete clinical success was achieved in 46 patients. Only four patients required second intervention. **Conclusion:** Our experience indicates a 98% success rate. No major complications were noted.

Key words: Ablation, computed tomography, osteoid osteoma

Introduction

Osteoid osteoma (OO) is a small benign, painful tumor occurring in children and in young adults. Its typical night pain is relieved by nonsteroidal anti-inflammatory drugs.[1] Computed tomography (CT) is the imaging of choice for visualization and localization of the nidus and for the treatment planning.

Surgery has the disadvantage to locate the nidus intraoperative, require extensive resection to reach to nidus, longer hospitalization stay, and chances of recurrence. In core, excision requires big hole, and sometimes residual nidus can create recurrence. CT-guided radiofrequency ablation (RFA) is a safe, minimally invasive, and cost-effective treatment for OO.

Mechanism of radiofrequency ablation

An electric arc is formed between a generator, a grounding pad, a patient, and a needle electrode or between a generator, a patient, and the needle electrodes. The target tissue offers high resistance as compared to electrodes while alternating current passes through it. This creates profound agitation in the ions of the tissue near the exposed electrodes. Heat is produced by marked friction. By controlling the radiofrequency energy, we can deliver the desired heat. The needle used is small as compared to the ground pad so that heat can be focused. The amplitude of the temperature and duration of heating determines tissue injury and zone of cell death. The cells are irreversibly damaged by 4–6 min at 50°C–55°C. The tissue DNA and RNA coagulates at 60°C–100°C with destruction of cellular enzymes. Tissue charring occurs above this temperature or when tissue impedance is more than 100 ohms. So for, RFA 50–100°C is required for 4–6 min. The rate of heat conduction from the electrodes to the target tissue being slower, the time period may be 10–20 min. Heat energy must be applied to cover the tumors including the outer rim of 5–10 mm surrounding tissue. Treated tissues shrink and scarring occurs.

Materials and Methods

A total of fifty patients were referred to our tertiary care center hospital in Ahmedabad, Gujarat (38 male and 12 female). All patients were radiographed in anteroposterior and lateral planes. CT scan was also done. All patients show typical nidus formation, diagnostic criteria for OO [Table 1]. The patients or their relatives were explained in detail about the procedure, its benefit, and probable failure of the procedure. Written consent was taken from the patients or their relatives. Minor profile blood investigations such as bleeding time, CT, prothrombin time, international normalized ratio, hepatitis B surface antigen, and HIV tests were performed before the procedure. Procedure was approved by the Review Board of our institution.

Procedure was done on outpatient basis. All procedures were under general anesthesia. CT scan was done with a section of 5 mm and 1 mm section thickness to localize OO. With the guidance of CT images, patients' limb was properly adjusted, and the access point was marked. Skin was painted and drapped. Bony access [Figure 1] was established with 11-G bone biopsy needle. Through a track created by the drill hole, RF electrode was connected to RF generator [Figure 1; case 1 to case 3]. The temperature at the tip of electrode was monitored during the procedure. Ablation was performed for about 5–6 min at temperature of 90°C.

Postprocedure CT scan was done to observe any hematoma formation at the site or soft tissue edema. Patient was advised follow-up of 1 week. After 1 week follow-up, patient was advised for further follow-up at 3 months. Procedure was regarded successful if RF electrode could be placed within the center of nidus and could be heated to the desired temperature. Total symptoms free were considered those patients where the initial symptoms were not appreciated by the patients after 2 weeks of procedure. Symptoms observed before the treatment and after 2–3 weeks of treatment if same were considered as a recurrence of the lesion.

Results

Typical rest pain was completely relieved in 46 patients within 1–2 days of procedure. All medication for pain was discontinued after the procedure in these 46 patients giving a success ratio of 92%.[2] All patients resumed their normal routine from 2nd day onward. In three patients, we have to repeat the procedure because of 1–2 cm off-centering because

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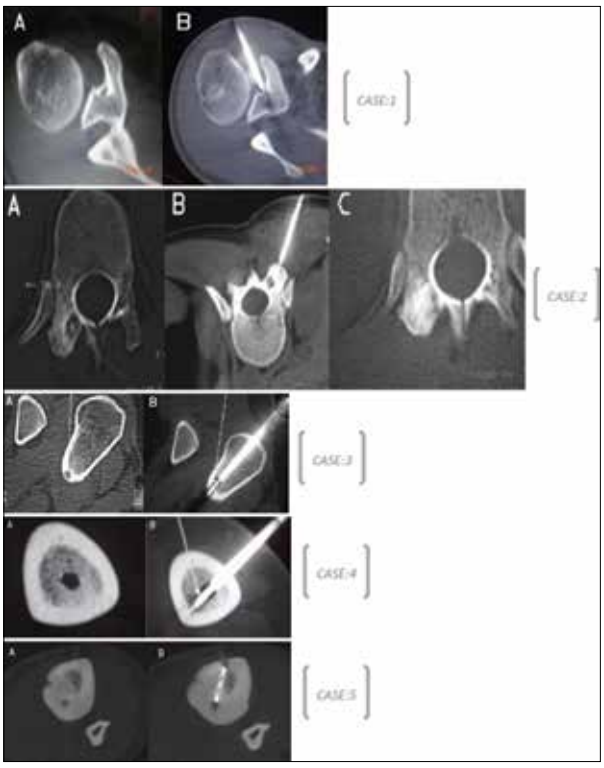

Figure 1: Case 1 (A) osteoid osteoma of glenoid cavity; (B) radiofrequency electrode placement Case 2: (A) osteoid osteoma of posterior element of vertebra; (B) radiofrequency electrode treatment in prone position; (C) Treated sclerosed lesion Case 3: Nidus in neck of left femur posteriorly (A) Entry from opposite cortex (B) to avoid neurovascular injury. Case 4: Intramedullary nidus of tibia without sclerosis (A) offers no resistance while drilling. Overshooting off-centering at first attempt of electrode positioning (B) Case 5: Significant sclerosis in a tibial osteoid osteoma (A) Difficult navigation during access of this lesion resulted in breakage of drill beat (B)

Table 1: Location of osteoid osteoma

Site	Number of patients (%)
Femur	34 (68)
Tibia	11 (22)
Spine	2 (4)
Scapula	1 (2)
Inferior pubic rami	2 (4)

of electrode position in the first sitting [Figure 1; case 4]. In one patient, there was breakage of drill beat in RFA tract due to hard bone [Figure 1; case 5]. Regular follow-up at 3–6 months show no evidence of recurrence of symptoms. Radiological follow-up also shows obliteration of nidus after 1 year.

Discussion

There are different treatment options for OO including surgical treatment and RFA. Surgical treatment involves large resection of normal bone to ensure complete removal of tumor.[3] This causes structural weakening and requires a long period of limited weight bearing and limited activities.[4,5] Surgery is also difficult in sites such as acetabulum, glenoid, and femoral head and neck region. The disadvantage of surgical treatment makes RFA a good alternative. RFA involves the use of thermal coagulation of the nidus to induce necrosis in the OO. The clinical success ratio of surgical method is nearly 88%–100%.[6] RFA also gives nearly the same result. RFA was preferred because it is a day-care procedure, does not require hospital stay, and also has a short recovery time. In our study, clinically successful treatment was performed in 92% of cases. This result is comparable to a similar study done by Yoshiki Asayma and others where they have achieved 75%–87% success rate.[2]

Various needle guidance approaches have been described as minimally invasive and effective methods for the percutaneous treatment of OO such as CT guidance,[7] fluoroscopic guidance,[8] and ultrasonography guidance, but CT-guided RFA has advantage of highly resolved visualization of bone structures and rapid frame rate.[9] CT is a good technique to visualize the nidus.

Previous studies documented complications such as skin burn, skin and fat necrosis, soft tissue infection, and hematomas.[10] In our study, there was no such complication.

Conclusion

In our view, CT-guided percutaneous ablation is a simple, noninvasive, safe, and effective technique for the treatment of OO and can be offered as the treatment of choice in most of the cases. It is also a choice of treatment when surgery fails.

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Conflicts of interest

There are no conflicts of interest.

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