Percutaneous Radiofrequency Ablation of Osteoid Osteoma

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Abstract

Background: Osteoid osteoma is benign bone tumor that accounts for approximately 11% of all benign bone tumors. Pain is the hallmark of its clinical presentation, and is dramatically relieved by aspirin or non-steroidal anti-inflammatory drugs. Complete surgical resection has historically been the treatment of choice. En-bloc excision often requires a long incision, extensive dissection and, frequently, internal fixation. Minimally invasive therapies, such as percutaneous radiofrequency (RF) ablation, have recently been developed. The use of RF ablation to treat osteoid osteoma was described to be safe, effective and avoids drawbacks of surgery.

Purpose: To report our experience in treating osteoid osteoma in different sites by RF ablation regarding the technical and clinical success, safety, complications, short and long-term follow-up.

Patients and Methods: Between November 2006 and June 2012, 120 patients underwent CT-guided percutaneous RF ablations for osteoid osteoma. Most of the lesions were located in the long bones, most commonly in the femur (n=74), followed by the tibia (n=31), humerus (n=6), 3 cases were in iliac bone, 3 in the lumbar vertebrae and 1 in the scapular glenoid, 1 in the acetabulum and 1 in the cervical spine. The patients did the procedures under spinal or general anesthesia using a 9mm exposed-tip probe radiofrequency probe Soloist Single Needle Electrode. Patients were followed-up at 1 week, 1 month, and every 3 months thereafter in the first year and another visit after 2 years.

Results: The technical success rate was 100%. Within the follow-up period (6-24 month) 13 patient (10.8%) missed the follow-up visits; with the overall clinical success in the rest of the patients (89.2%) whom showed no pain recurrence. All patients had initial prompt pain relief and were able to return to their normal activities and discontinued analgesics. Two patients (1.6%) had recurrence of pain after 6 months and underwent repeat radiofrequency ablation. Two patients (1.6%) with a tibial shaft lesions developed superficial skin burn (epidermolysis), which responded well to conservative treatment.

Conclusion: We believe that percutaneous RFA is a safe and effective treatment for osteoid osteoma with significant advantages over surgery. It has a high clinical success rate and low incidence of complication.

Key Words: Osteoid osteoma — Small bone tumors — Radiofrequency (RF) ablation — Minimally invasive therapies.

Introduction

OSTEOID osteomas are benign tumors of the bone that accounts for approximately 11% of all benign bone tumors and typically seen in children and young adults [ii. They cause inflammation, local effects on normal tissue from tumor expansion, and secondary effects and complications (e.g., scoliosis, osteoarthritis) [2].

Localized pain is the hallmark of its clinical presentation, and is dramatically relieved by aspirin or non-steroidal anti-inflammatory drugs. However, such long-term medical therapy may be =acceptable because of the complications from chronic use of anti-inflammatory agents. Complete surgical resection has historically been the treatment of choice for osteoid osteoma, with success rates of 88%-97% for en bloc open resection [3,4]. Lesion resection leaves a bone defect that may be vulnerable to fracture and in some cases, may necessitate internal fixation and bone grafting [5-7] Minimally invasive therapies, such as percutaneous excision followed by alcoholization, percutaneous radiofrequency (RF) ablation or laser ablation, have recently been developed [8]. The use of RF ablation to treat osteoid osteoma was described to be safe, effective and avoids drawbacks of surgery [7,9].

This study was conducted on 120 patients with osteoid osteoma to report our experience in treating osteoid osteoma in different sites by RF ablation regarding the technical and clinical success, safety, complications, short and long-term follow-up.
Patients and Methods

Between November 2006 and June 2012, 120 patients (89 males and 31 females) underwent CT-guided percutaneous RF ablations for osteoid osteoma. The age range of the patients was 4-36 years (mean 18 years).

All patients were complaining of pain that was worsened at night. The duration of pain ranged from 3 months to 5 years (mean 2.8 years). All patients regularly received analgesics mostly non-steroidal anti-inflammatory for pain relief.

In all of the patients except one, RFA was the primary treatment for osteoid osteoma. The remaining 1 patient had undergone curettage and excision of the nidus with pain recurrence 3 months after surgery.

The majority of the nidi were located in the long bones, most commonly in the femur (n=74), followed by the tibia (n=31), humerus (n=6), 3 cases in iliac bone, 3 in the lumbar vertebrae and 1 in the scapular glenoid, 1 in the acetabulum and 1 in the cervical spine.

Treated lesions were 2-19mm in diameter (mean, 6.2mm).

Pre-interventional evaluation included a detailed medical history, a thorough clinical examination, plain radiographs, computed tomography (CT) and in some cases magnetic resonance imaging (MRI) and isotopic bone scan.

A specific written informed consent has been taken from the patient or his/her parent (if the patient was less than 18 years) before being treated.

Procedures:

All procedures were performed on the basis of 1 day admission procedure. The procedure was performed in the CT unit on (Light Speed 4 rows GE, Milwaukee WI USA) or (Asteon 4 four-channel Toshiba, Tokyo, Japan). An unenhanced axial CT scan (1-mm slice thickness, 120 kV, and 80 mAs) of the lesion was obtained.

The trocar of the needle was then removed; and a 9mm exposed-tip probe radiofrequency probe (Soloist Single Needle Electrode- Boston scientific USA) was inserted through an outer co-access (Boston scientific) needle into the lesion. The electrode was connected to the RF generator (RF 3000 Boston scientific USA) and 4 grounding pads were applied to both thighs and connected to the RF generator. In a 4-year boy the thigh regions were not enough for grounding pads and 2 pads were applied to flanks. The RF generator were turned on and the power was set to 2 Watt and increased by 1Watt every one minute till highest impedance reached and automatic power shut-off occurred. Before starting a second RF cycle in the same session 1 minute waiting is left, then a start point with a power setting equal to 70% of the end power number of the first cycle. The start power is kept for 5 minutes and if shut-off point is not reached, the power was increased by 1 step every minute till shut-off.

In lesions larger 10mm the nidus was divided into two parts and two cycles were applied to each part by the same electrode (Fig. 4).

The electrode was withdrawn from the lesion at the end of treatment, and the skin incision was covered with a self-adhesive dressing. All patients were discharged in the same day of the procedure. Before discharge, the procedure and grounding pads sites were examined for any bleeding, hemato- ma, and burns.

After the procedure patients were allowed to resume their daily activities with no restrictions. Patient with lesions in weight bearing bones were allowed to bear full weight the day next to the procedure. Post-procedural treatment includes oral antibiotics for 1 week and non-steroidal anti-inflammatory for 24-72 hours according to the presence and intensity of the procedure related pain.

Outcome and follow-up:

Patients were followed-up at 1 week, 1 month, and every 3 months thereafter in the first year and another visit after 2 years.

In the 1 week visit the procedure and grounding pads sites were examined for healing any signs of infection and burns. Also the patient was asked to report about pain if any and its intensity.
In the next visits the patient was asked to report if he had any pain similar to the pre procedure pain. Patients who did a pre procedure isotopic bone scan were asked to do a 1 year follow-up bone scan.

Results

This study included 120 patients of whom 119 patients (99.1%) had RF ablation as the primary treatment of their lesions, while 1 patient (0.9%) underwent RF ablation after failed open surgical intervention of the nidus 1 year earlier (See Fig. 1-4).

The technical success rate was 100%; the RF electrode was placed within the nidus of all lesions.

All patients had initial prompt pain relief and were able to return to their normal activities and discontinued analgesics in the first 6 months. Two patients (1.6%) had recurrence of pain after 6 months and underwent repeat radiofrequency ablation; both of them had a lesion in the proximal tibia measuring 15 and 19mm and they achieved good pain relief after the second RFA session.

Two patients (1.6%) with a tibial shaft lesions developed superficial skin burn (epidermolysis), which responded well to a short course of antibiotic therapy and topical creams with no serious scarring.

One patient (0.8%) suffered from laryngeal spasm during the procedure which was controlled by the anesthesiologist.

Within the follow-up period (6-24 month) 13 patient (10.8%) missed the follow-up visits; with the overall clinical success in the rest of the patients (89.2%) showed no pain recurrence.

Fig. (1): Right femoral neck osteoid osteoma treated by RFA.

Fig. (2): Osteoid osteoma of the proximal tibia treated by RFA.
Fig. (3A): Axial CT image showing the lucent nidus with calcified center and surrounding reactive sclerosis.

Fig. (3B): The RF electrode seen in the nidus through the bone biopsy needle.

Fig. (3C): Bone scan anterior view before RFA showing corresponding active tracer (hot) uptake in the left side of L5.

Fig. (3D): One year follow-up bone scan after RFA, both the anterior and the posterior views showing no tracer activity.

Fig. (3): Osteoid osteoma in the left lamina of L5 vertebra treated by RFA.

Fig. (4A): Axial CT image showing the upper part of the large mottled calcified nidus.

Fig. (4B): Axial CT image showing the middle part of the lesion.

Fig. (4C): Axial CT image showing the most caudal part of the nidus.
Fig. (4D&E): Axial CT image showing the RF electrode hit the upper part of the nidus.

Fig. (4F): After completion of the RFA cycles of the upper part the RF electrode is redirected to hit the lower part of the nidus.

Fig. (4G-D): The upper and lower needle tracks after finishing the two procedures.

Fig. (4): Large right glenoid osteoid osteoma treated by RFA.

Discussion

Osteoid osteoma is a small, painful, benign bone tumor that occurs most frequently during the first 3 decades of life which was classically treated by surgery. Precise intra-operative localization of the nidus is often difficult and en-bloc excision often requires a long incision, extensive dissection and, frequently, internal fixation as a prophylaxis against fracture through the operative site [10,11]. Numerous studies showing excellent results for the treatment of osteoid osteoma with percutaneous radiofrequency ablation [4,9,12-17] with reported success varies between 77 and 100%.

We had a 100% technical success rate to access the nidus by the RF electrode similar to almost all of the previous studies.

Our clinical success rate was (89.2%) which is less than Ockendon et al., 2011 [17] (96%) this is due to; with our larger number of patients (120 patients) compared to their 23 patients we had more patients who were lost during the follow-up period (13 patients). However our clinical success rate is near to 91% rate of Rosenthal et al., 2003 [9] study where in their large series (263 patients) reported considerable patients missing during the follow-up period. In the review article by Motamedi et al., 2009 [7] they reported that clinical success rates between 89% and 95% for primary treatment have been widely reported and that these results compare favorably with those of surgical treatment and other less invasive therapies, such as CT-guided percutaneous resection and laser ablation.

As the highest rate of pre-procedure biopsy confirmation of osteoid osteoma (73%) reported by Rosenthal et al., 2003 who stated that non-diagnostic biopsy findings did not have detectable effect on the probability of successful outcome and that clinical and imaging features are usually diagnostic we did not routinely obtain specimens before RF ablation.

Our series included four spinal lesions three in the lumbar spine and one in the cervical spine; all lesions were located in the posterior neural arch with close anatomic relation to dura and/or neural structures. In agreement with the recommendation of other authors Motamedi et al., 2009 [7], Rosenthal et al., 2003 [9], Barei et al., 2000 [12], we believe that spinal osteoid osteomas should be treated with RF ablation only if the nidus is located at least 1cm from vulnerable structures to prevent them from being damaged.

In our patients with lesion larger 10mm we carried the procedure by dividing the lesion into
two parts and hit the lesion by the same electrode in different sites in the same session with a zone of overlap (Fig. 4) to insure complete nidus ablation, in contrary to other authors [5,9] who used two or more electrode to cover the lesion completely.

We agree with almost all researchers that RFA offers several advantages over surgery; first as all of our patients were discharged in the same day of treatment compared to at least 5 days hospital stay after surgery reported in most of the studies. Second, early resuming of daily activity and full weight-bearing after RF ablation in weight-bearing bones with no fracture reported in our study compared to prolonged periods of protected weight bearing required after resection. Third, none of our patients needed cast or internal fixation compared to surgical treatment. Lastly, precise CT-guided localization of the nidus during RFA is a considerable advantage compared to fallacies to locate the lesion at open excision which is a well-recognized complication.

In conclusion, we believe that percutaneous RFA is a safe and efficacious treatment for osteoid osteoma with significant advantages over surgical excision. Such treatment option has a high clinical success and low complication rate which makes it the treatment of choice for appendicular osteoid osteomas.

References


