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High-frequency radio-wave ablation of osteoid osteoma in the lumbar spine

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Abstract The authors report on the first known application in the spine of percutaneous ablation of osteoid osteoma using radio-frequency waves. The technique involves a CT-guided biopsy of the lesion followed by introduction of a 1-mm probe connected to a radio-frequency lesion generator. The procedure was performed on an outpatient basis and the patient experienced immediate relief of his symptoms. No evidence of recurrence was demonstrated 16 months later. The technique described may become the procedure of choice in the surgical treatment of osteoid osteoma, as it minimises surgical trauma and post-operative pain.

Longer follow-ups are required to monitor the incidence of recurrence.

Key words Osteoid osteoma · Percutaneous biopsy · Radio frequency · Denervation · Back pain

Case report

A 24-year-old physical education teacher presented with a 1-year history of disabling left-sided low back pain with intermittent irradiation to the left thigh. No previous history of trauma or other cause for the onset of symptoms was reported. The patient's past history was unremarkable. He had initially sought conservative treatment through physiotherapy and chiropractic manipulation and had required daily analgesia with no significant benefit.

Over the 6 weeks preceding the assessment by the senior author (O.L.O.), he had been unable to work because of further deterioration of his back symptoms. On examination a mild right lumbar scoliosis was noted which was not fully correctible in lateral bending. There was marked tenderness over the left L3-4 apophyseal joint with moderate restriction of lumbar movement, both in flexion and extension. Straight leg raising was unrestricted and there was no evidence of neurological involvement in the lower limbs. The patient denied any specific difficulties of bladder or bowel function.

Imaging included plain radiographs, a bone scan with SPECT, and a CT scan (Figs. 1–3).

The procedure was carried out using neuroleptic anaesthesia (midazolam and fentanyl) supplemented by local infiltration with

lignocaine and bupivacaine. The patient was positioned prone in the CT scanner (Toshiba Express SX).

A core biopsy of the lesion was then carried out using a Cook trephine needle (Cook Bone Biopsy Set, Cook, Australia) (Fig. 4), which was followed by radio-wave ablation using a radio-frequency generator (Radionics RFG-6) with a 1-mm electrode at 85°C for 4 min. The electrode was introduced percutaneously through a 2-mm guiding cannula and positioned into the nidus. The cannula insulates the electrode throughout its length except for the terminal 5 mm.

The patient was discharged from hospital 2 h after the procedure and reviewed at 6 weeks, 3 months and 16 months later. Relief of preoperative pain was reported 24 h after the operation. Two weeks later the patient was able to return to work as a physical education teacher in a full-time capacity with no restrictions. Histopathology confirmed the diagnosis of an osteoid osteoma (Fig. 5).

At the 16-month follow-up, clinical examination revealed full and pain-free lumbar range of movement with no localised tenderness. There was no evidence of neurological deficit in the lower limbs.

Imaging carried out at that stage demonstrated residual thickening of the left L4 neural arch, but with no evidence of recurrent or residual nidus (Fig. 6).

Fig. 1 Radiograph showing lumbar scoliosis with sclerosis of the left L4 pedicle

Fig. 2 Bone scan demonstrating increased uptake on the left side at L4

Fig. 3 CT scan demonstrating the nidus of the osteoid osteoma at L4

Fig. 4 Operative CT scan demonstrating the insertion of the biopsy needle into the nidus

Fig. 5 Microphotograph of biopsy specimen (H&E $\times 250$) demonstrating nidus of bone with minimal stroma consistent with osteoid osteoma

Fig. 6 CT scan at 16 months following the procedure, demonstrating no evidence of recurrence. Some bony thickening of the pedicle persists

Discussion

The first description of the pathology of osteoid osteoma is attributed to Bergstrand by Kneisl and Simon [10]. Jaffe reported five cases in 1935 [8]. Anecdotal reports of similar cases had been published by Heine in 1924, Hitzrot in 1929 and Milch in 1934 [18].

Spinal location of osteoid osteoma is not uncommon, predominantly in the lumbar spine and in the pedicles [3, 20].

The majority of cases are observed in the first three decades of life and the presenting complaint is usually pain [11, 19, 20]. Scoliosis is a commonly associated feature [8].

Treatment of osteoid osteoma may initially be conservative as this condition has been reported as self-limiting [5, 19]. In the presence of ongoing symptoms, surgical excision of the nidus is recommended [6] with good resolution of preoperative pain noted within the 1st week [2].

In the spine, as for the appendicular skeleton [3], complete excision of the nidus may be made difficult by site and inaccuracy of localisation. Too much excision of the sclerotic bone in an effort to localise the nidus may sometimes compromise the strength of the bone and lead to postoperative fracture [12].

Intra-operative and preoperative adjunctive techniques have been described such as radioactive isotope bone scanning probes to facilitate localisation [3]. Subsequent spinal stabilisation may be necessary if excision of the osteoma involves disruption of facet joints and/or pedicles.

In recent years reports have been published of excision of osteoid osteoma using percutaneous techniques under fluoroscopy or CT guidance. These generally involve small tubesaws, bone trephines [15, 22] and, more recently, radio-frequency probes [4, 16, 17].

Specific complicating features may be represented by the sclerotic nature of the bone surrounding the nidus,

which can deflect needles and guide wires used for localisation of the lesion.

Rosenthal et al. [17] reported on 18 patients with osteoid osteoma in the appendicular skeleton treated by radio-wave ablation. One of the patients in the series had incomplete resolution of symptoms, and another patient had a further recurrence following two previous surgical excisions. In the report by deBerg et al. [4], there was one recurrence in a series of 18 patients with osteoid osteoma of the appendicular skeleton treated with radio-wave ablation.

Rosenthal et al. [16] stated that, based on laboratory experience, tissue necrosis following heat generation by the probe was expected in an area of up to 13 mm.

In our case, positioning of the radio-frequency probe followed core biopsy with a Cook trephine needle. This created an ideal path for the 1-mm probe under CT control. We used the physical parameters suggested by Rosenthal et al. (85°C for 4 min), and this achieved ablation of the nidus with immediate symptomatic benefit and no evidence of recurrence 16 months after the procedure.

The theoretical risk of thermal damage to neural structures in close proximity to the area treated was addressed by Houpt [7]. Based on their elegant study it is highly unlikely that a probe placed within bone will result in inadvertent thermal lesions to neural tissue. It is paramount, however, that the position of the probe be constantly monitored by adequate imaging.

We believe that our case supports the use of percutaneous high-frequency radio-wave ablation of osteoid osteoma as the procedure of choice to minimise surgical trauma, postoperative pain and complications, and enhance functional recovery.

Longer-follow-up studies are required to monitor incidence of recurrence.

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