Radiofrequency ablation of osteoid osteoma

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Chapter 1

Introduction

Osteoid osteomas were first described by Jaffe in 1935 (1). They represent 10-15% of all benign bone tumours and mainly occur in the lower extremity (femur and tibia) of children and young adults. A spinal location is seen in 10% of osteoid osteomas. Osteoid osteomas are more common in males than females (ratio 2:1). Most affected individuals complain of pain typically worsening at night. Associated function loss may be present. The pain is often relieved by treatment with salicylates or other non-steroidal anti-inflammatory drugs. The mean duration of symptoms prior to diagnosis is 16 months (2-4).

Histologically osteoid osteomas are composed of a variably calcified small nidus composed of osteoblasts and osteoid. These are arranged in a meshwork pattern and are embedded in a fibrous stroma containing vascular and neural structures (2-4).

Radiographically, osteoid osteomas present as a radiolucent nidus with surrounding sclerosis. Conventional radiographic features are often subtle. The imaging features of osteoid osteoma are better demonstrated on thin-slice computed tomography (CT) (1-2 mm thickness). Radiographic criteria for the diagnosis of osteoid osteoma are the presence of a radiolucent nidus, usually not larger than 1.5 cm, with surrounding reactive sclerosis and often periosteal reaction. Osteoid osteomas demonstrate increased activity on bone scintigraphy. The role of magnetic resonance imaging (MRI) in the diagnostic work-up of osteoid osteoma is unclear. The associated bone marrow edema visible on MRI has been reported to lead to erroneous diagnoses such as a stress fracture or even a malignant bone tumour (2-4).

Until the early nineties surgery was the treatment of choice for osteoid osteomas. Apart from the localization problem of osteoid osteomas during surgery, post-operative complications are reported in 20 – 45% of patients (2). Complications include fractures especially in weight bearing bones such as the tibia (2). Other major post-surgical

complications are infection and neurovascular injury (5;6). Bruneau et al described a rupture of the vertebral artery after surgery on a cervical osteoid osteoma (5).

The disadvantages of surgery have initiated the development of image-guided techniques such as percutaneous CT-guided radiofrequency ablation (2). Rosenthal et al (7) described in 1992 the first successful clinical application of CT-guided radiofrequency ablation in the treatment of osteoid osteoma. Radiofrequency ablation aims at the precise delivery of heat to the target tissue. High-frequency alternating current transmitted through the radiofrequency ablation electrode induces local ionic agitation and frictional heat resulting in coagulation necrosis (2).

CT-guided radiofrequency ablation is a less invasive treatment of osteoid osteoma. As a primary treatment radiofrequency ablation yields similar results as surgery (8), but with less complications. Complications related to radiofrequency ablation of spinal and non-spinal osteoid osteoma are infrequent and are related to inadvertent heating (skin burns) (7-15). Contrary to surgery (5;6;16-23), no major complications (infection or neurovascular injury) have been reported after radiofrequency ablation for spinal and non-spinal osteoid osteoma (7-15). Moreover, radiofrequency ablation can be easily repeated after initial treatment failure.

PURPOSE AND OUTLINE OF THE THESIS

The main purpose of this thesis was to evaluate the effectiveness and safety of CT-guided radiofrequency ablation for the treatment of spinal and non-spinal osteoid osteomas. Furthermore, the technical requirements needed for safe radiofrequency ablation and the clinical outcome after radiofrequency ablation of spinal and non-spinal osteoid osteomas are discussed. The possible causes of treatment failure and methods for the detection of treatment failure were also analysed with the purpose of optimizing patient selection and the radiofrequency procedures, and solving high risk parameters for failure of treatment.

Chapter two discusses the clinical outcome of a large series of 97 patients with spinal and non-spinal osteoid osteomas treated by radiofrequency ablation. **Chapter three** describes the theoretical and technical background of radiofrequency ablation. The concept of the treatment zone as well as related safety issues are also discussed. In **Chapter four** the possible mechanisms causing treatment failure are discussed. The potential role of CT and MRI imaging in the detection of recurrent or residual osteoid osteoma is addressed in **Chapter five**. Finally the treatment outcome of a group of 25 patients with spinal osteoid osteoma treated by radiofrequency ablation is presented in **Chapter 6**. A general discussion is provided in **Chapter 7**.

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