بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

MONA MAGHRABY

Advances in Management of Osteoid Osteoma by Radiofrequency Ablation

A Thesis

Submitted for Partial Fulfillment of Master Degree in Radiodiagnosis

By

Mohamed Hamdy Mounir Abd El Hakim
M.B.B.Ch

Supervised by

Prof. Dr. Waleed Hetta
Professor of Radiodiagnosis and Interventional Radiology
Faculty of Medicine - Ain Shams University

Dr. Rasha Tolba Khattab
Lecturer of Radiodiagnosis
Faculty of Medicine - Ain Shams University

Faculty of Medicine
Ain Shams University
2021

سورة البقرة الآية: ٣٢

Acknowledgment

First and foremost, I feel always indebted to ***ALLAH,*** *the Most Kind and Most Merciful.*

I'd like to express my respectful thanks and profound gratitude to ***Prof. Dr. Waleed Hetta,*** *Professor of Radiodiagnosis and interventional radiology Faculty of Medicine - Ain Shams University for his keen guidance, kind supervision, valuable advice and continuous encouragement, which made possible the completion of this work.*

I am also delighted to express my deepest gratitude and thanks to ***Dr. Rasha Tolba Khattab,*** *Lecturer of Radiodiagnosis Faculty of Medicine - Ain Shams University, for her kind care, continuous supervision, valuable instructions, constant help and great assistance throughout this work.*

Mohamed Hamdy Mounir

List of Contents

Title	Page No.
List of Abbreviations	i
List of Tables	ii
List of Figures	iv
Introduction	1
Aim of the Work	4
Review of Literature	
Osteoid Osteoma	5
Technical Considerations in CT-Guided Radiofrequency Ablation of Osteoid Osteoma	27
Special Considerations	48
Patients and Methods	61
Results	65
Illustrative Cases	89
Discussion	94
Summary and Conclusion	104
References	106
Arabic Summary	—

List of Abbreviations

Abb.	Full term
CT	Computed tomography
MRI	Magnetic resonance imaging
NSAIDs	Non-steroidal anti-inflammatory drugs
OO	Osteoid Osteoma
RF	Radio Frequency
RFA	Radiofrequency ablation
SPECT	Single-photon emission computed tomography
STIR	Short time inversion recovery

List of Tables

Table No.	Title	Page No.
Table (1):	Age and sex distribution of studied group	67
Table (2):	Median age of studied group	67
Table (3):	Pain relieve among different age groups.	68
Table (4):	Age among cases with different treatment outcome.	68
Table (5):	Pain relieve among males and females.	69
Table (6):	Lesion location in all 25 patients	70
Table (7):	Clinical Data and Lesion Size in Relation to Treatment Failure or Success.	72
Table (8):	Lesion characteristics and number of needle position among studied group.	73
Table (9):	Pain relieve among cases with different lesion size.	74
Table (10):	Pain relieve among cases with different number of needle position.	75
Table (11):	Pain relieve among cases with different coagulation time.	76
Table (12):	Distribution of the CT healing pattern in successfully and unsuccessfully treated patients.	82
Table (13):	Pain relieve among cases with different CT findings.	83
Table (14):	CT healing pattern in successfully and unsuccessfully treated patients divided in two subgroups according to duration of follow-up with CT scanning	84

List of Tables Cont...

Table No.	Title	Page No.

Table (15): Bone and/or soft tissue changes on MRI before and after radiofrequency ablation (RFA) in successfully and unsuccessfully treated patients (because of the limited number of patients in the MRI follow-up group, statistical analysis could not be performed). 86

Table (16): Comparison of the MRI delay time (dynamic MRI enhancement) in successfully and unsuccessfully treated patients, before and after radiofrequency ablation (RFA) (because of the limited number of patients in the MRI follow-up group statistical analysis could not be performed). 88

List of Figures

Fig. No.	Title	Page No.
Figure (1):	Different parts of long bone	8
Figure (2):	Different types of bone tissue	8
Figure (3):	Histologic features of osteoid osteoma.	12
Figure (4):	Coronal reformatted CT image shows a cortically based sclerotic lesion (arrow), a finding consistent with a diagnosis of osteoid osteoma	17
Figure (5):	Spinal osteoid osteoma	17
Figure (6):	Lesion localization in a 17-year-old boy	18
Figure (7):	Approach planning	18
Figure (8):	Posterior spot image from technetium-99 bone scan shows focal radiotracer uptake within nidus (arrow) and less-pronounced tracer uptake within left femoral intertrochanteric region, illustrating scintigraphic double-density sign	20
Figure (9):	B18-month-old boy with left acetabular roof osteoid osteoma	22
Figure (10):	Osteoid osteoma	27
Figure (11):	Principles of radiofrequency thermal ablation	30
Figure (12):	Equipment used in radiofrequency ablation	33
Figure (13):	Step by step technique of radiofrequency ablation of osteoid osteoma in the left distal femur of 20-years- old man	39
Figure (14):	Graph shows treatment-zone volume as function of current intensity	46

List of Figures Cont...

Fig. No.	Title	Page No.
Figure (15):	15-year-old boy with 1.5 cm osteoid osteoma of left acetabulum, requiring multiple ablation positions	51
Figure (16):	Multidetector CT scans of 1.8 cm long recurrent osteoid osteoma of right anterior tibia in 14-year-old boy	52
Figure (17):	Coronal T1-weighted MR image of technique demonstration case, a rare epiphyseal osteoid osteoma in 21-year-old man	54
Figure (18):	18-year-old man with osteoid osteoma of left index finger metacarpal.	55
Figure (19):	22-year old man with osteois osteoma of junction body and left pedicle L3 vertebra	57
Figure (20):	Primary osteoid osteoma of right anterior iliac crest in 14-year-old boy	59
Figure (21):	Coagulation time among studied group	73
Figure (22):	Transverse unenhanced CT image of the right ischium (pelvis) obtained with patient in prone position shows radiofrequency ablation electrode in place. Lesion (arrow) was difficult to access because of its location deep within the ischial bone	77
Figure (23):	Transverse unenhanced CT images of cervical spine obtained with patient in prone position	78
Figure (24):	Transverse unenhanced CT image of right hip obtained with patient in supine position	79
Figure (25):	Treatment outcome among studied group	80

List of Figures Cont...

Fig. No.	Title	Page No.
Figure (26):	CT findings among studied group.	82
Figure (27):	Pain relieve among cases with different CT findings	83
Figure (28):	Axial gadolinium-enhanced T1 FFE	87
Figure (29):	Case 1	89
Figure (30):	Case 2	90
Figure (31):	Case 3	91
Figure (32):	Case 4	92
Figure (33):	Case 5	93

INTRODUCTION

Osteoid osteomas were first described by Jaffe in 1935. They represent 10-15% of all benign bone tumors 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 ***(Bruners et al., 2013).***

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 ***(Trueta, 2014).***

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 tumor ***(Elgazzar and Shehab, 2015).***

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. Complications include fractures especially in weight bearing bones such as the tibia ***(Elian and Sadek, 2015).***

Other major post-surgical complications are infection and neurovascular injury. Bruneau et al described a rupture of the vertebral artery after surgery on a cervical osteoid osteoma ***(Anchlia et al., 2019).***

The disadvantages of surgery have initiated the development of image-guided techniques such as percutaneous CT-guided radiofrequency ablation. Rosenthal et al 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 ***(Barile et al., 2017).***