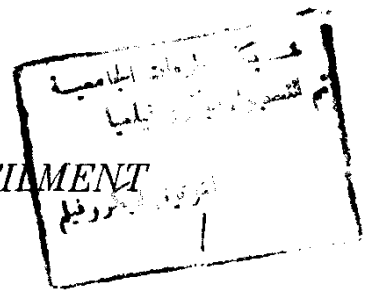
ROLE OF MAGNETIC RESONANCE IMAGING IN BONE MARROW DISORDERS



THESIS

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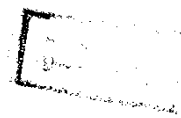

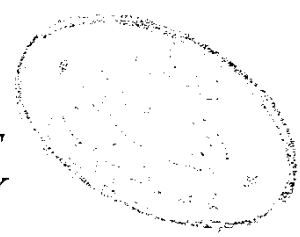

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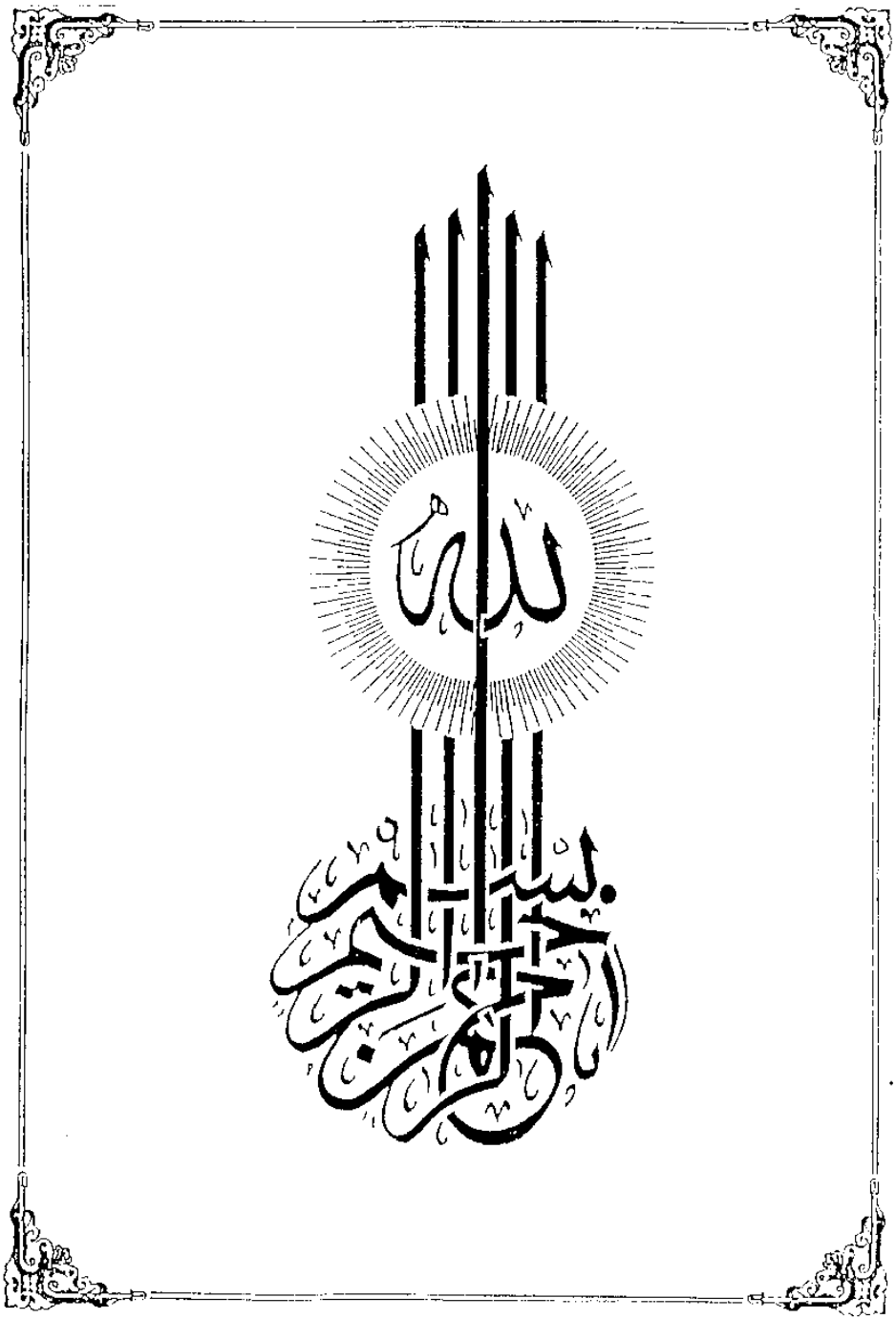

Abstract

This study was designed to study the role of magnetic resonance imaging in bone marrow disorders. At first we started by the normal anatomy and physiology of bone marrow followed by physical principles of MRI in bone marrow, examination techniques and MR appearance of normal marrow, then pathology of bone marrow disorders and MR manifestations with illustrative cases and finally the summary and conclusion.

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INTRODUCTION
AND
AIM OF WORK

Introduction and aim of the work

Within the confines of the human skeleton lies one of the larger and most important organs of the body, the bone marrow. Except for bone, muscle, and fat, it is the largest organ of the body by weight (Volger and Murphy, 1988).

Bone marrow contains three major components: osseous matrix, myeloid tissue (red), and adipose cells (yellow) (Moore et al, 1991).

In 1868, the role of bone marrow in blood cell production was first recognized (Neumann, 1968). Since that time, tremendous insight into the anatomic and physiological aspects of bone marrow was occurred, much of it by tedious in vitro investigation. Methods of medical imaging now exist for invivo assessment of certain anatomic features and physiologic functions. In recent years, these methods have contributed to rapid improvement in fundamental understanding of bone marrow and conditions that alter its anatomy and physiology (Volger and Murphy, 1988).

Diagnosis and monitoring of bone marrow disorders with radiographic methods have not been of great value owing to the insensitivity of existing techniques. Bone marrow infiltration was demonstrated only by marrow aspiration or biopsy. However, MRI has brought marrow

disorders into the realm of the radiologist (Kaplan et al, 1987).

Magnetic Resonance Imaging has opened new possibilities to current diagnostic radiology in the evaluation of bone marrow. In the past, bone marrow imaging was based on conventional radiology, nuclear medicine, and computed tomography, they all exhibited some capabilities but also some limitation mainly due to their inability to distinguish between yellow and red marrow. Bone marrow image of MR scans is due to bone marrow (it is the only modality that direct images the bone marrow) with its different components of red and yellow marrow. Since red marrow is mostly liquid and yellow marrow contained a large amount of fat, the signal will vary on T_1W images (Pozzi et al, 1990).

Bone marrow contains a large proportion of mobile protons in fat and water in cellular haemopoietic and stromal tissue (the high fat content gives a strong signal and is thus very clearly visualized). It is therefore ideally suited for study with MRI.

MR imaging has three important advantages in imaging of bone marrow. First, inherent contrast between normal marrow component and pathologic processes is great. Second, these are negligible reconstruction artifacts from cortical bone. Third, true coronal and sagittal images

can be obtained allowing evaluation of the longitudinal extent of disease. It provides excellent spatial resolution, anatomic detail and the unique ability to separate haemopoietic (red) marrow from fatty (yellow) marrow (Edelman and Hesselink, 1990).

The first two reports of MRI application to bone marrow disease dealt with children with osteomyelitis and neoplastic disease (in 1984 and 1985) (Cohen, 1991).

The aim of the work is to study the role of MRI in identifying bone marrow disease, in distinguishing between different diseases, in staging of diseases and in monitoring therapy.

Disorders which originate from the osseous componant of bone marrow (primary bone tumours and infections etc.) are not included in our study, but only mentioned as a differential diagnosis.

NORMAL BONE MARROW ANATOMY AND PHYSIOLOGY

Normal Bone Marrow Anatomy and Physiology

Within the confines of the human skeleton lies one of the larger and most important organs of the body, the bone marrow. Except for bone, muscle, and fat, it is the largest organ of the body by weight, approaching 3000 g. in adult men and approximately 2600 g. in women (Volger and Murphy, 1988).

This is a soft pulpy tissue which is found not only in the cylindrical marrow cavities of the long bones but also in the spaces between the trabeculae of all bones and even in the larger Haversian canals. It differs in composition in different bones and at different ages, and occurs in two forms, yellow and red marrow. The innumerable minute spaces between the trabeculae, together with the much larger cavities in the shafts of the longer limb bones, are occupied in life by marrow, in some cranial bones air filled cavities develop and these are termed pneumatic (Gray's, 1973).

Bone marrow contains three major components: osseous matrix, myeloid tissue (red), and adipose cells (yellow). (Moore et al, 1991).

Many details are known about the osseous, vascular, neurologic, lymphatic, and microscopic anatomy of bone marrow.