بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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Role of Ultrasound in Management of Acute Osteomyelitis in Pediatric Patients

Thesis

Submitted for partial fulfillment of M.D. in
Radiodiagnosis

By

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Marwa Hosni Bedair Abdelrasoul

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List of Abbreviations

Abb.	Full term

1GCs: .....First-generation cephalosporins
AHO: .....Acute hematogenous osteomyelitis
ASP: .....Anti-staphylococcal penicillin
ATP: .....Adenosine Triphosphate
CRP: .....C-reactive protein
CT: .....Computed Tomography
ESPID: .....European Society for Pediatric Infectious Diseases
ESR: .....Erythrocyte sedimentation rate
GAS: .....Group A Streptococcus
IV: .....Intravenous
K Kingae: .....Kingella kingae
M-CSF: .....Macrophage colony-stimulating factor
MRI: .....Magnetic Resonance Imaging
MRSA: .....Methicillin-resistant S aureus
MSSA: .....Methicillin-sensitive S aureus
OPAT: .....Outpatient parenteral antimicrobial therapy
OPG: .....Osteoprotegerin
PGE2: .....Prostaglandin E2
PGI2: .....Prostaglandin I2
PICC: .....Peripherally inserted central catheter
PO: .....Per-oral
RANK: .....Receptor activator of nuclear factor Kappa
RANK-L: .....Receptor activator of nuclear factor Kappa – Ligand
S aureus: .....Staphylococcus aureus
STIR: .....Short-tau inversion-recovery (STIR)
TLC: .....Total leucocytic count
US: .....Ultrasound

INTRODUCTION

Osteomyelitis refers to infection of the bone by a bacterial agent that occurs either through direct innoculation from a traumatic event, or through spread of infection from nearby infected tissue as in case of septic arthritis or cellulitis. In children, hematogenous spread is the most common route of infection. The most common implicated organism is Staphylococcus aureus, followed by Streptococcus pnemuoniae, Haemophilus influenzae, and Salmonella species. The latter pathogen is a common cause of osteomyelitis among patients with sickle cell anemia. [1,2]

The clinical symptoms of osteomyelitis are usually non-specific and include fever, pain, redness, edema and limitation of movement of the affected limb. In infants, poor feeding and irritability may be the only symptoms present. According to the duration of the symptoms, osteomyelitis is classified into acute, subacute or chronic infection; the illness is said to be acute if the symptoms lasted for less than 2 weeks at the time of diagnosis, subacute if the symptoms lasted from 2 weeks to 3 months, and chronic if the symptoms lasted for longer than 3 months. [3]

The approach to diagnosing osteomyelitis especially in the early stage remains a challenge yet is of paramount importance to avoid development of irreversible complications and possible loss of the limb. Usually a multimodal approach is needed to establish the diagnosis, including detailed history, careful physical examination, and routine lab tests as complete white blood cell

counts (WBC), erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP). In addition, imaging modalities play a critical role in diagnosing osteomyelitis. Different modalities including plain X-ray, US, MRI, CT and bone scintigraphy have all been used to establish the diagnosis. [3,4]

Plain X-ray is the first radiological modality used to investigate osteomyelitis as it is widely available and relatively inexpensive. However, it has low sensitivity and specificity in detecting bone changes in early stages of the disease. Bone marrow edema, which is the earliest sign of osteomyelitis, is not visible on plain films. Additional radiological findings in the early stages may include soft tissue swelling, muscle swelling, loss of trabecular architecture and periosteal reaction secondary to elevated periosteum. However, these findings are not specific to osteomyelitis and are associated with other conditions as stress fractures and soft tissue infections. [1,5]

MRI offers an important imaging tool for initial evaluation of osteomyelitis. It has an advantage over plain X-ray because of its ability to detect bone marrow changes within 3-5 days from the onset of infection. It can also visualize sinus tracts, fistulas and abscesses by the aid of gadolinium contrast. A major disadvantage, however, is that MRI is relatively expensive and is not readily available in many facilities. In pediatric patients, sedation may be required, making the study more time consuming and exposing the patients to the potential side effects of the sedating drugs. Moreover, MRI is contraindicated in patients with certain implant devices, and is not well-tolerated by patients who are claustrophobic. [1,4]

CT is readily available and is relatively less expensive compared to MRI. It is also better in detecting early bone marrow edema as well as necrotic tissue compared to X-ray. It can also be used as a guide in aspiration and needle biopsies. However, the potential hazards of radiation exposure of the CT greatly limit its use, especially in pediatric population. [4]

The effectiveness and reliability of US in assessment of osteomyelitis in the early stage is not widely discussed in the literature. US offers a valuable imaging modality given its widespread availability and low cost. Moreover, ultrasound can be performed at bedside, and poses minimal risk to the patients. US can detect early changes in osteomyelitis as soft tissue swelling and subperiosteal collection, as well as guide aspiration of the collection to determine its nature. Color Doppler images also aids in diagnosis by detecting increased vascularity of the surrounding soft tissue. US is exceptionally superior in children due to loose adherence of the periosteum to the underlying cortex. [3-4]

AIM OF THE WORK

The aim of our study is to demonstrate the role of US in early detection of acute osteomyelitis in pediatric patients, as well as highlight its importance in guiding the clinicians for the most appropriate treatment plan for each patient.

Chapter 1

ANATOMY AND PHYSIOLOGY OF BONE

The skeletal system in our body is composed of bones, cartilages, ligaments and other tissues that perform crucial functions in our body. Bone tissue, also known as osseous tissue, is a hard, dense connective tissue that forms the internal support system of the human body [5,6].

Bones are often thought of as static structures which only offer structural support. However, they function as an organ; besides providing shape to the human body, bones permit locomotion, motor capability, provide protection to vital organs, and play a vital role in homeostasis by producing different blood cells from the marrow that is essential for survival. Bones are continuously undergoing structural and biological changes throughout life according to the body's demands and the surrounding environmental factors [6].

Gross anatomy

The human skeleton is divided into two parts: the axial skeleton and the appendicular skeleton. The axial skeleton make up the central core unit, and consists of the skull, vertebrae, ribs, and sternum. The appendicular skeleton comprises the bones of the extremities. The human body consists of 213 bones, 126 of which are part of the appendicular