Original Article
Utilization of Diagnostic Musculoskeletal Ultrasound Scan in Clinical Practice: The Irrua Specialist Teaching Hospital Experience.

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Abstract

Background: Soft tissue lesions of the musculoskeletal system are commonly encountered in clinical practice, often manifesting as palpable masses. Ultrasound scan is increasingly being used for the evaluation of these masses and can serve as an excellent investigative modality for the clinical practitioner because certain clinical and imaging findings give accurate diagnosis in some cases. Although ultrasound scan is readily available, relatively inexpensive and provides high-contrast resolution images, clinical request for musculoskeletal ultrasound scan is quite low in our health institutions thus necessitating this study.

Aim: To illustrate the relevance of musculoskeletal ultrasound scan in clinical practice.

Methods: Retrospective data of patients that underwent soft tissue ultrasound scan in the Department of Radiology, Irrua Specialist Teaching Hospital, Irrua, Edo state, Nigeria from August 2016 to May 2017 was collected and analyzed to determine age, sex distribution, clinical indication for the procedure and the findings.

Results: A total of 3,698 patients were referred for ultrasound scan, 24 of these were request for musculoskeletal ultrasound scan. Of these patients, 58.3% were males, 41.7% were females, age ranging from 8 months to 60 years with a mean age of 27.7years. The commonest indication was suspected non-inflammatory conditions (75%). The most frequent abnormality seen on ultrasound scan was tumors of fatty origin accounting for 37.5%.

Conclusion: The use of musculoskeletal ultrasound scan in the evaluation of soft tissue lesions cannot be over emphasized. There is low referral rate from clinical practitioners.
We thus encourage the use of musculoskeletal ultrasound scan as the primary investigative tool for musculoskeletal lesions.

Keywords: Musculoskeletal, masses, ultrasound scan, clinician, utilization.

Introduction

The radiologic evaluation of soft tissue masses has changed dramatically within the last two decades[1]. Before the introduction of computer-assisted imaging, assessment of clinically suspicious soft tissue masses was usually limited to radiographs[1]. Although radiographs were sensitive in the identification of adipose tissue and soft

tissue mineralization, they provided little other diagnostic information.

The earliest report of application of ultrasound in the evaluation of musculoskeletal system disorders was published in 1972[2].To our knowledge, literature publication of the utilization of musculoskeletal ultrasound in our environment is rare. A recent study in the USA showed significant increase in musculoskeletal ultrasound utilization over the past decades with as high as 316% increase in the number performed between 2000 to2009[3].

Musculoskeletal ultrasound involves the use of high frequency sound waves to image soft tissues such as tender muscles, nerves, cartilages, joints, etc and bony structures for the purpose of diagnosing pathology or guiding real time interventional procedures[4]. Radiological evaluation of musculoskeletal masses has changed dramatically with the continued improvement of imaging technology[5], thus increasing clinical application and allowing acquisition of dynamic information[1]. Although the choices available for imaging evaluation of musculoskeletal masses have changed dramatically, the basic objectives have remained the same: diagnosis and management[5].

The application of ultrasound to musculoskeletal conditions continues to expand and it has become the primary modality of imaging[6]. The wide availability and improvement in technology coupled with portability, low cost, use of non-ionizing radiation and its safety makes ultrasound a preferable first choice imaging modality for the evaluation of musculoskeletal disease[7]. Ultrasound scan also has the benefit of quick scan time with real-time dynamic examination. It also allows contralateral examination and does not pose limitations due to metal artifacts which can be problematic in Magnetic Resource Imaging (MRI)[8]. Clinical presentation of the disease, ultrasound skills with its prerequisite anatomical knowledge makes the diagnosis more precise and reduces uncertainties in the choice of therapy[8].

There are several applications of real-time dynamic ultrasound examination in the musculoskeletal system. It can be used in imaging both inflammatory and non-inflammatory diseases, traumatic and degenerative soft tissue conditions [7,8] such as cellulitis, abscesses, pyomyositis, disease of the joints like Baker's cyst, infectious tenosynovitis, necrotizing fascilitis[8,9], septic arthritis, carpal tunnel syndrome, adhesive capsulitis, extensor carpi ulnaris, joint effusions, diagnosis of intra-articular bodies, rheumatoid tenosynovitis, tendon tear, soft tissue masses and infections of the extremities, differentiating cystic from solid masses and identifying their vascularities [7,8,9]. Other indications include identification of soft tissue foreign bodies, developmental dysplasias, ultrasound guided biopsy and aspiration and other indications where MRI is contraindicated such as in patients with metallic implants[2, 8, 9,10,11,12]. Musculoskeletal sonography is also invaluable in sports medicine, where it can be used to identify traumatic joint effusions, occult fractures and fissures, joint inflammation, muscle and tendon rupture [8,13].

Infection of the musculoskeletal system can be associated with high mortality and morbidity if not promptly and accurately diagnosed[14]. These infections are generally diagnosed and managed clinically, however, clinical and laboratory findings sometimes lack sensitivity and specificity

and a definite diagnosis may not be possible[14] . In certain situations, imaging is frequently performed to confirm the diagnosis, evaluate the extent of the disease and aid the treatment plan[14]. Although many imaging findings of infectious diseases can overlap with non-infectious processes, imaging can help establish the diagnosis when combined with the clinical history and laboratory findings[14].

Integrated ultrasound imaging (using B-mode and Color Doppler) plays a fundamental role in the study of periskeletal soft tissue tumor for both diagnosis and treatment planning[15]. It permits the integration of conventional morphostructural parameters with biofunctional data of lesion flow patterns and relative qualitative features thus differentiating benign from malignant soft tissue tumors[15].

Despite these advantages, the use of musculoskeletal ultrasound scan has some limitations. Ultrasound scan is operator-dependent with poor repeatability[7]. Even with advances in the resolution of the transducer, deeper structures like bone marrow may be difficult to visualize as the higher frequency transducers have lower tissue penetration[7]. Another limitation is the restricted access to certain joints such as the metacarpophalangeal joints which are difficult to image with an ultrasound probe[7]. In addition, examination of multiple joints in clinical setting may be time consuming[7].

These factors may necessitate the use of other imaging modalities especially cross sectional modalities either as first line radiologic investigation or complementary modality. Plain radiography is commonly the first line imaging modality of bone and soft tissue diseases in most of our health institutions because of its availability and low cost[16] and is the cornerstone of imaging evaluation of joints[16]. Radiography is sensitive to the identification of adipose tissue and soft tissue calcification[16]. But it is of little value in soft tissue imaging due to its intrinsically poor contrast of soft tissues[1].

Cross sectional imaging including Computed Tomography (CT) scan and MRI provide detailed anatomical information in the evaluation of soft tissues due to their inherent high spatial and contrast resolution[14]. Deeper structures and multiple areas can be imaged in one acquisition[14]. There are distinguishing CT characteristics that can suggest a specific diagnosis including the lesion`s mineralization pattern, density, pattern of adjacent bone involvement, degree and pattern of vascularity[17]. Magnetic Resonance Imaging has become a valuable technique in the evaluation of musculoskeletal system because of its excellent soft tissue differentiation and its ability to obtain images in multiple planes[1,18]. It not only is maximally sensitive to the presence of musculoskeletal soft tissue lesions, but also provides exquisite definition of their features[19]. Magnetic Resonance Angiography accurately reveals the arterial and venous supply of vascular tumors[18]. Contrast enhanced MRI is the most sensitive technique for the detection of synovitis, ligament tears, chondral lesions and it is the only modality that can detect bone marrow edema which is an indication of active inflammation[20], osteonecrosis, occult fractures; primary and secondary neoplasm and metastases[20,21].

Radionuclide bone scan is of value in evaluating the extent of osseous involvement or in detecting unsuspected skeletal metastasis[18]. Positron Emission Tomography (PET) using fluorine-18-fluro-2-deoxy-D-glucose is useful in metabolic imaging[10,22,23]. It is used as an adjunct in the

preoperative evaluation of suspected soft tissue masses, differentiating malignant from benign tumors depending on their differential uptake ration[10,18].

Materials and Methods

This study is a retrospective analysis of patients that were referred to the Department of Radiology, Irrua Specialist Teaching Hospital, Irrua, Edo state who had soft tissue ultrasound scan performed on them by Consultant Radiologists from August 2016 to May 2017. Ethical approval was sought and granted by the hospital ethical committee. Irrua is situated in Esan land, some 87Km North of Benin-City. It is the headquarters of Esan Central Local Government area in Edo state. The locals are the Esan speaking people. Irrua Specialist Teaching Hospital is one of the tertiary health care centres in Edo state which carters for patients in Edo state as well as those referred from Delta, Ondo, Ekiti, Kogi and other neighbouring states.

B-mode ultrasound scan was done using a high frequency 7.5 MHz curvilinear transducer (Mindray DUS 2013 model manufactured by Shenzen Mindray Biomedical Electronic Company Limited, Shenzen China). Emphasis was placed on scanning the area of swelling and comparing with the contralateral normal area or limb. Longitudinal and transverse images were obtained. Color Doppler studies were occasionally done to ascertain the vascularity of the lesions. The data obtained were recorded using tables. Statistical analysis was done with Chi-square test using SPSS version 21.0 software. Results were presented in figures and tables using comparative percentage.

Results

A total of 3,698 patients were sonographically examined from August 2016 - May 2017 of which, 24 patients were referred for musculoskeletal ultrasound scan.

Table I: Socio-demographic characteristics of participants

Age (Years)	Frequency	Percentage
?1	3	12.5%
1-20	6	25%
21-40	9	37.5%
41-60	6	25%
Total	24	100%
Mean ± SD=27.72		
Male	14	58.3%
Female	10	41.7%
Total	24	100%

A higher proportion of these participants were of the age group 21-40years (37.5%). Majority of them were males (58.3%) while percentage of females was 41.7% (Table I).

Table 2: Clinical indication for scan.

Clinical Indication	Frequency	Percentage
Inflammatory	6	25%
Non-inflammatory	18	75%
Total	24	100%

Based on the clinical information provided by the referring clinician, 6 (25%) had suspected inflammatory conditions like abscess, cellulitis, while 18 (75%) had suspected non-inflammatory conditions i.e. tumors of various soft tissue origin (Table II)

Table 3: Ultrasound scan findings.

Ultrasound Diagnosis	Frequency	Percentage
Fatty tumors	9	37.5%
Abscess	6	25%
Muscular tumors	3	25%
Mixed Muscular and fatty tumors	2	8.3%
Others	4	16.7%
Total	24	100%

Ultrasound scan findings include; abscesses (25%), tumors of fatty origin (37.5%), muscular tumors (12.5%), mixed muscular and fatty tumors (8.3%) and others (16.7%) which include bone tumors and tumors of vascular origin including aneurysm (Table III).

Fifty percent (50%) of the participants that had tumors of fatty origin were within the age group of 41-60 years. Abscess (66.7%) was seen in those less than one year of age. More females (50%) had tumors of fatty origin as compared with males (28.6%). A higher proportion of males (57.1%) had other tumor types (tumors from bone, vascular tumors).

Discussion

A total of 3,698 patients underwent a B-mode ultrasound scan in our department; out of which only 24 (0.0065%) were for musculoskeletal. This is a reflection of a very low referral rate for musculoskeletal ultrasound scan in our environment. This finding is similar to earlier reports from several authors. Iovane et al[15] reviewed B-mode and Color Doppler findings of 43 patients with palpable periskeletal soft tissue masses. Blankstein et al[24] also had a small sample size of 34 patients like ours. However, some authors had larger sample sizes. Hung et al[25] carried out a study in Shatin, Hong Kong and evaluated 714 (seven hundred and fourteen) patients with superficial soft tissue tumors. This is a reflection of increased referral and utilization of musculoskeletal ultrasonography by clinicians. All our 24 patients (100%) had abnormal findings on ultrasound scan. This seems to confirm the high sensitivity of musculoskeletal ultrasound. Hung et al[25] concluded in their study that the diagnostic accuracy of musculoskeletal ultrasound in the assessment of superficial musculoskeletal soft tissue tumors is high and determined an overall accuracy of 79%. Sensitivity and specificity for identifying malignant superficial soft tissue tumor was 94.1% and 99.7% respectively[25]. Increased observer awareness of specific tumor entities increases the sensitivity and specificity of ultrasound diagnosis[25].

Musculoskeletal tumors are histologically classified based on the tissue type they affect[26], ranging from benign subcutaneous lipoma to

malignant deep high grade sarcoma[27]. The commonest tumor types recorded in this study were tumors of fatty origin only. This made up 37.5% of our patients and found in the 41-60years age group (50%), affecting more females. Fat-containing tumors are the most commonly encountered soft tissue masses clinically[28] and vast majorities are benign[28]. They demonstrate a characteristic appearance on ultrasound scan which is identical to subcutaneous fat[12, 28]. Study by Murphy et al[12] reported that soft tissue lipoma accounts for almost 50% of all soft tissue tumors and radiologic evaluation is diagnostic in up to 71% of cases[12].

The usual onset of lipoma is within the age range of 40-60years, rare in children and the cause is unclear but could be hereditary. It has equal incidence in males and females[5,29] Sonographically, lipomas are relatively hyperechoic when compared with adjacent subcutaneous fat but could be hypoechoic or isoechoic[30, 31, 32]. Inampudi et al[31] showed a wide range of appearance of biopsy proven lipomas in their study. They recorded that 17% were hypoechoic, 59% isoechoic, 24% were hyperechoic compared to adjacent subcutaneous fat[30], no acoustic shadowing, no or minimal color Doppler flow[30]. Heterogeneous echotexture, presence of Color Doppler flow or large size is suspicious of liposarcoma[30].

Six (25%) of our patients had inflammatory disease diagnosed sonographically as abscess. Fifty percent (50%) of these cases that were diagnosed as abscess were found in the age group of less than one year. Abscesses can occur in any age group when there is a skin infection that is untreated, when the immune system is compromised due to systemic illness or medication[33]. Ultrasound scan is usually the first investigation to evaluate suspicious abscess. Abscesses are manifestations of cellulitis and necrotizing fascitis[33]. It lies within the dermal and subdermal cutaneous layers. Sonographically, abscesses appear as poorly defined anechoic or hypoechoic fluid collection with or without echogenic borders and with or without septae. Sediments or even gas may be seen within the central fluid collection. Compression with the transducer may induce movement or swirling of the abscess content. Also, Cobblestone appearance of surrounding subcutaneous tissues due to edema from associated cellulitis may be seen[33].

A limitation of this study was absence of confirmatory histopathologic diagnosis of tissue sample from our patients.

Conclusion

The management of patients with soft tissue masses needs careful assessment and appropriate use of investigational tools to obtain a diagnosis. Ultrasonography is well suited to identify location, size and extent of musculoskeletal masses because of its high diagnostic accuracy which can be improved through increased Radiologist awareness of the characteristic appearances of these disease entities. A better interaction among Surgeons, Radiologists and Pathologists would enable adequate staging of musculoskeletal tumors and better planning of definitive treatment of patients.

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