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Original Investigation

Clinical utility of bone scintigraphy in patients with limb pain of suspected musculoskeletal origin

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Abstract

Objective: To determine the clinical utility of bone scintigraphy in patients with limb pain of suspected musculoskeletal origin.

Material and Methods: All patients aged ≥18 years who were referred for diagnosis and management of limb pain were diagnosed on the basis of history, physical examination, and investigations excluding bone scintigraphy. After the presumptive diagnosis was made (the pre-test diagnosis), all subjects underwent bone scintigraphy, or if they had a previous bone scintigram for their pain condition, the results of that scintigram were reviewed. Then, the pre-test diagnosis was reviewed in light of the bone scintigraphy findings and repeat clinical assessment as needed. The post-test diagnosis was considered either as unchanged diagnosis or changed diagnosis for the region or regions of interest.

Results: There were 118 females (54.8%) and 97 males (45.2%). The mean age of the entire group was 36±8.1 years (range: 18-87 years). The mean duration of the symptoms was 17.4±11.2 months (range: 1-264 months). Of the 215 subjects, 212 had a bone scintigram. Of these 212 subjects, none had a changed diagnosis.

Conclusion: In the evaluation of limb pain of suspected musculoskeletal origin, scintigraphy is unlikely to alter the pre-test diagnosis or affect treatment decisions after history, physical examination, and non-scintigraphic investigations. The clinical utility of scinitigraphy in this setting is low.

Keywords: Pain, diagnosis, scintigraphy, bone scan, nuclear medicine, clinical utility

Introduction

Conventional bone scintigraphy has long had many uses in the assessment of musculoskeletal disorders (1, 2). Scintigraphy is a functional examination that visualizes bone metabolic lesions developing in the course of benign and malignant diseases that normally precede any structural lesions that can be visualized by conventional radiographic methods (3). Scintigraphy can be used in the differentiation of systemic inflammatory diseases involving bones and joints, traumatic lesions, and degenerative joint lesions (2, 4). In practice, the most common isotopic markers are technetium (99mTc)-labeled bisphosphonates. Scintigraphic scans may be supplemented by single photon emission computed tomography (SPECT) scans, facilitating spatial 3D acquisition capabilities typical of all tomographic techniques, allowing for precise determination of locations in which the radioisotope is accumulated (5).

The clinical utility of bone scintigraphy in the assessment of patients presenting with limb pain (whether it is expressed as mono- or polyarthralgia or regional pain) is not known. Clinical utility has been defined as the extent to which diagnostic testing improves health outcomes relative to the current best alternative, which could be some other form of testing or no testing at all (6). Bone scintigraphy is highly sensitive. With few exceptions, a normal bone scintigram (lack of pathological uptake of the radionuclide marker) excludes active osteoarthropathies (4). Thus, the clinical utility may lie both in its negative predictive value and also the fact that it is highly sensitive to both joint disease as well as sites of tendon and bursal inflammation (7-11). The management of tendonitis and bursitis may differ considerably from the management of joint diseases. The implication for the patient (i.e., the ability to tell the patient they do not have arthritis) is also valuable. Scintigraphy can aid in this diagnostic process.

To date, there has been only 1 study to consider the clinical utility of bone scintigraphy in the routine assessment of patients presenting with ≥1 areas of pain in the limbs, where the pain is suspected to have a musculoskeletal source (12). Fisher et al. (12) reported on a retrospective chart review of a mix of subjects with pain in ≥2 peripheral joints. Their retrospective audit was undertaken to determine if bone scintigraphy influenced their practice. By this, they meant whether the results of a bone scan altered the diagnosis. They found that in a cohort of 44 subjects, bone scintigraphy suggested a disorder that differed from the pre-

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test clinical diagnosis in only 3 patients. They found that 1 in 6 reports identified joint regions not recorded clinically, and they implied that further assessment of these subjects did not lead to new diagnoses. Though not clearly reported, bone scintigraphy results did increase the subsequent ordering of more tests, and this was considered a drawback by the authors. However, there are a number of methodological concerns with this study, namely the lack of clinical data presented (very little information has been included about presentation or diagnoses) and the selection process. Thus, the clinical utility of bone scintigraphy in routine use remains undefined for patients presenting with limb pain of suspected musculoskeletal origin.

The purpose of the current study was to examine the clinical utility (in terms of diagnosis) of bone scintigraphy in consecutive patients referred to a rheumatology center with limb pain suspected to have a musculoskeletal origin. Thus, the study examined whether knowledge of the report of bone scintigraphy, following a prior clinical diagnosis, leads to any change in diagnosis or management.

Material and Methods

Subjects and setting

Over a period of 6 months in 2012-2013, in 2 large primary care clinics in Edmonton, Alberta, Canada, all patients referred for assessment of joint or limb pain to the author received a diagnosis, followed by bone scintigraphy (or a search for a previous bone scintigram result). These clinics serve a catchment area of 1.5 million persons, with a large and varied clinical spectrum of patients. The patients were referred to the author, who acted as a consultant for the assessment of musculoskeletal and rheumatic diseases.

Procedure

Each referred patient underwent history and physical examination as deemed appropriate by the examiner. The examiner was usually provided with additional history and had access (through electronic medical records) to all investigations to date. The examiner made a preliminary diagnosis, usually on first assessment. After the diagnosis, the patient was asked if they had ever had a bone scan for their current symptom of concern and the electronic medical records were reviewed for evidence of a prior bone scintigram. If bone scinitigraphy had been completed, the report was reviewed on the following day. In cases where there was no bone scan, the patients were given the option of obtaining a bone scan, with the pros and cons of this procedure presented verbally. After the bone scintigraphy results were available (either because they had already been present or a scan was performed), the author examined his pre-test diagnosis and the scintigraphy report. The author checked the entirety of the report for any diagnostic or pathological term or reference made by the radiologist that could be linked to the clinical diagnosis. The author then determined if the material identified in the report differed from or could change the pre-test diagnosis. If there was even a remote possibility of there being a change, the author reviewed the patient's chart and the patient as needed. In addition, if the radiologist recommended further imaging, that imaging was ordered if clinically appropriate.

After review of the bone scan findings, review of the patient and chart where needed, and review of any additional investigation recommended by the radiologist, the post-test diagnosis was made and compared with the pre-test diagnosis. The post-test diagnosis was considered either as unchanged diagnosis or changed diagnosis.

Subjects were excluded if they were aged <18 years, if they reported the results of a previous bone scan to the author before he could make a presumptive diagnosis, if the referring physician made known the results of a bone scan at the time of referral, if the patient had a history of current or previous malignancy, if there was a known limb fracture at the site of pain for which the subject was referred, if the referral was made with a clear diagnosis and only management was the reason for referral, or if the subject did not obtain a bone scan. Patients were not excluded if they had axial symptoms, as spinal pain was common in this population.

Data Collection

Data were collected for the following parameters: age, sex, duration of symptoms for which the referral was made, number of subjects with pre-referral bone scintigraphy completed specifically for the symptom of interest, pre-test diagnosis, post-test diagnosis, and type and number of additional radiological procedures recommended by the radiologist after bone scintigraphy.

Data analysis

Descriptive statistics were calculated for age, sex, and duration of symptoms for which the referral was made. Pre-test diagnoses were tabulated with the authors' usual terminology, and subjects could have multiple diagnoses (e.g., bursitis, tendinitis, and osteoarthritis could all be present in the same patient, particularly those presenting multiple sites of pain).

Ethics

Ethics approval for this study as a practice audit was obtained from the Health Research Ethics Board of Alberta.

Results

In total, 256 patients were assessed for limb pain. Of these, 41 were excluded (16 because the bone scan results were made known to the author prior to his presumptive diagnosis, 10 because the diagnosis was clear and referral was for treatment only, 8 because of a history of malignancy, 4 because of a traumatic fracture, and 3 because they did not obtain a bone scan). Thus, there were 215 eligible subjects.

There were 118 females (54.8%) and 97 males (45.2%). The mean age of the entire group was 36±8.1 years (range: 18-87 years). The mean duration of the symptoms was 17.4±11.2 months (range: 1-264 months). Of the 215 eligible subjects, 189 had the pre-test diagnosis established at first visit, and the remaining 26 subjects had the diagnosis within 6 weeks of the first visit.

On a review of electronic records, 116 of the 215 subjects were found to have a bone scintigram that had been conducted for their symptoms. The remaining 99 were referred for bone scintigraphy. All but 3 of these had bone scintigraphy. Thus, a total of 212 subjects had a pre-test diagnosis and a bone scintigram for evaluation of the possible alteration of the post-test diagnosis. All scintigrams results (whether they were available on the electronic medical record or required a new requisition) were reviewed only after the pre-test diagnosis was made.

The number of subjects with a variety of pre-test diagnoses is shown in Table 1. The various pathological terms identified in the radiological reports are shown in Table 2. Because the subjects could have multiple diagnoses in the region of interest or presented with multiple limb pains and could also have multiple terms used for findings on their bone scintigraphy reports, the total numbers of diagnoses and terms exceeds the number of subjects.

In 17 subjects, the radiologist reported a lesion found on bone scintigraphy that was described as possibly benign but for which further radiological investigation was advised. Of these, the recommended investigations were MRI (1), plain radiography (12), ultrasound (2), and CT (2). In 12 cases, no lesion was identi-

Table 1. Diagnoses given to subjects by the examiner. A given subject may have >1 diagnosis

Diagnosis	Number of subjects with diagnosis (out of 212)
Achilles tendinitis	4
Acromioclavicular osteoarthritis	6
Ankle osteoarthritis	5
Anserine bursitis	34
de Quervain's tendinitis	44
Elbow osteoarthritis	1
Fibromyalgia	67
Glenohumeral osteoarthritis	8
Gout	23
Hip osteoarthritis	38
Knee osteoarthritis	108
Medial or lateral elbow epicondylitis	37
Osteoarthritis of finger (including thumb) joints	37
Plantar fasciitis	18
Radiocarpal osteoarthritis	12
Reflex sympathetic dystrophy	2
Rheumatoid arthritis	25
Rotator cuff tendinopathy	56
Spondyloarthropathy with appendicular involvement (including Behcet's disease, psoriatic arthritis, ankylosing spondylitis, reactive arthritis, and inflammatory bowel disease arthropathy)	18
Stress fracture	4
Systemic lupus erythematosus	8
Trochanteric bursitis	41

fied on subsequent imaging. In the remainder, the diagnoses included enchondroma (3) and enthesopathy (2), none of which affected the treatment plan, or in the case of enthesopathy, were not already captured by the pre-test diagnosis.

Discussion

This study shows that routine ordering of bone scintigraphy in patients referred for pain in ≥1 regions of the limbs is of low clinical utility. Knowledge of the bone scintigraphy result is unlikely to alter the pre-test diagnosis or affect management decisions. The Choosing Wisely project (13, 14) is an initiative of the American Board of Internal Medicine (ABIM) Foundation to help reduce overuse of tests and procedures. Therein, various leading medical specialty societies have identified tests or procedures commonly used in their field whose necessity should be questioned and discussed. Along this theme, until it can be shown that routine use of scintigraphy brings high clinical utility in the assessment of limb pain, given the costs involved and radiation exposure, it should not be a routine approach.

There are a number of limitations to the study. The study was limited to a single center and to patients selected by family physicians for referral, mainly because the limb pain was of suspected musculoskeletal origin. It is possible that these patients represent a select group in whom bone scintigraphy will be of limited clinical utility, because subjects with conditions such as reflex sympathetic dystrophy, metabolic bone disease, stress fracture, and inflammatory arthritis, for which scintigraphy may have a higher clinical utility, may not have been not referred. The subjects referred were likely to have conditions such as tendinitis, bursitis, osteoarthritis, and inflammatory arthritis. Therefore, it is not surprising that bone scintigraphy would yield results that affirmed the pre-test clinical diagnosis. That is, however, the point of this study. It is clear that the author was able to generate a pre-test diagnosis that was unaffected by bone scintigraphy. The diagnoses in this cohort can be established independent of bone scintigraphy.

Nevertheless, in the authors' experience, these are very common conditions and are commonly the conditions present when bone scintigraphy is ordered. Indeed, 116 subjects already had a bone scintigram before referral. This suggests that bone scintigraphy is frequently being used for these types of patients.

Another limitation may be the single consultant (the author) assessing each of these cases. The ideal approach would have been 2 different examiners making pre-test diagnoses and then examining the bone scinitigraphy results independently. Clinical skills and time available for history and physical examination may vary from one consultant to another. The assumption here is that the clinical skills of the consultant are not outside the typical expectation for a physician whose interest is musculoskeletal disorders and that the diagnoses reached (although they may vary in terminology) would not vary in terms of the effect a bone scintigraphy report would have on the post-test diagnosis. Nevertheless, scintigraphy in most patients with limb pain is unlikely to help the clinical process, with or without referral. The study population did include 2 cases of reflex sympathetic dystrophy, 1 case of stress fracture seen on X-ray, and several forms of inflammatory arthropathy. Even in each of these cases, the pre-test clinical diagnosis was not changed by the scintigraphy, but merely added confidence to the diagnosis.

This study should not detract from the use of bone scintigraphy in other disorders for which the technique is clearly an effective diagnostic tool, particularly reflex sympathetic dystrophy, stress fracture or infection, or pathological fracture or metastases where plain radiographs and clinical examination may not be sufficient. Rather, the study points to the need for the clinician to make a positive and confident clinical diagnosis of soft-tissue and joint inflammatory disorders, because scintigraphy will not change these diagnoses. Exposing patients to additional radiation and incurring the costs of scintigraphy may not be justified in a referral population with musculoskeletal pain merely to affirm a diagnosis. In addition, as Fisher et al. (12) have indicated, scintigraphy will also add to the investigation

Table 2. List of diagnostic and pathological terms present in bone scinitigraphy reports, as stated by the radiologist

Ankylosing spondylitis
Bursitis
Crystal arthropathy
Degenerative changes (appendicular joint)
Degenerative changes (spine)
Degenerative disc disease
Enthesopathy
Facet arthropathy
Gout
Inflammatory arthritis
Osteoarthritis (appendicular joint)
Osteoarthritis (sacroiliac joint)
Possible enchondroma
Psoriatic arthritis
Reflex sympathetic dystrophy
Rheumatoid arthritis
Rotator cuff tendinopthy
Sacroiliitis
Septic arthritis
Spondylitis
Spondyloarthropathy
Spondylosis
Stress fracture
Synovitis
Tendinitis
Tendonitis

burden. In the current study, there were 17 cases where additional radiology was recommended by the radiologist because of a finding on bone scan. The author felt compelled, as most physicians would, to follow-up on the advice of the radiologist, even to assess lesions not in the area of interest. In those 17 cases, either there was no lesion found on additional imaging or what was found was entirely benign. In future, a similar study should be performed in the primary care setting to see if the routine use of bone scintigraphy in unselected patients presenting with limb pain is likely to alter the pre-test diagnosis.

Ethics Committee Approval: Ethics committee approval was obtained from the Health Research Ethics Board of Alberta.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The author declared no conflict of interest.

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