Bone SPECT/CT for Assessment of Extremities and Joints

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Abstract

Planar bone scintigraphy is a radionuclide imaging used for the evaluation of many pathologies such as osteoarthritis, trauma, degeneration, infections and tumors in the joints of the upper and lower extremity. However, planar images cannot reach satisfactory results especially in the wrist, foot and ankle with complex structures and small bones. Recently use of Single Photon Emission Computerize Tomography/Computerize Tomography (SPECT/CT) is increasingly widespread. SPECT/CT combines scintigraphic findings with morphological findings. It provides accurate anatomical localization of increased radiotracer uptake and evaluates morphological changes of this area. SPECT/CT increases diagnostic accuracy and specificity of planar bone scintigraphy. It improves patient management and treatment planning. Although bone SPECT/CT application is widely used in oncology patients, the number of studies about the role of assessment in the extremities and joints are limited.

The aim of this review is to evaluate the contribution of bone SPECT/CT to the pathology of shoulder, elbow, hand-wrist, hip, knee, foot and ankle joint and to give examples from our cases.

ABBREVIATIONS

CR: Conventional Radiography; USG: Ultrasonography; CT: Computed Tomography; MRI: Magnetic Resonance Imaging; 3-PBS: Three-Phase Planar Bone Scintigraphy; WBS: Whole Body Scan; SPECT/CT: Single-Photon Emission Computed Tomography/Computed Tomography; Tc-99m MDP: Technetium-99m with Labelled Phosphonates Compounds Methylene(diphosphonate); Tc-99m HDP: Technetium-99m with Labelled Phosphonates Compounds Hydroxyethylidenediphosphonate; OM: Osteomyelitis

INTRODUCTION

The pathology of extremities and joints are common and patients’ quality of life is negatively affected. In these cases, early diagnosis is very important to avoid permanent damage. Treatment of extremities and joint diseases depend on the cause. The clinical examination and the findings of laboratory are sufficient for the diagnosis of pathologies of extremities in many patients. When clinical and laboratory examinations do not enough find an accurate diagnosis, the imaging methods are needed for diagnosis and treatment planning. Radiological imaging techniques such as conventional radiography (CR), ultrasonography (USG), computed tomography (CT), magnetic resonance imaging (MRI), and radionuclide imaging techniques such as bone scintigraphy, labelled leukocyte scintigraphy are widely used for assessing extremity bones, and joints. These techniques have many advantages, disadvantages, different sensitivities and specificities. CR may not often reveal pathology in the early stages, and it may not determine pathological changes exactly. USG is an inexpensive and non-invasive method for the evaluation of soft tissues but it cannot evaluate the bony structures. CT is important in evaluating the bone and surrounding soft tissues. MRI is important in evaluating the soft tissues, ligaments-tendons, and the bone marrow. However, both techniques have disadvantages such as poor image quality due to metal implants and inability to detect small structural changes. Also they may not determine the metabolic activity [1,2]. Recently, even though MRI has new software and hardware to reduce noise distorting the image quality; noise problem cannot be solved in the evaluation of prostheses after surgery especially on large joints, such as hip, and knees [1-4].

Bone scintigraphy is the most common use of radionuclide imaging technique for the evaluation of skeletal system [4]. It is available widely, easily performed, and inexpensive. Technetium-99m with labelled phosphonates compounds (methylene(diphosphonate), hydroxyethylidenediphosphonate etc.) (Tc-99m MDP, Tc-99m HDP) are used for bone scintigraphy. These compounds are collected in areas of increased bone turnover. Soft tissues and bones are evaluated with three-phase planar bone scintigraphy (3-PBS). After a bolus injection of the Tc-99m with labelled phosphonates compounds, dynamic perfusion images are obtained. Blood pool images are acquired after perfusion images. Whole body and static images are
obtained 2-4 hours after injection. Soft tissue is evaluated with perfusion, and blood pool; bone is evaluated with whole body scan (WBS) and static regional images. Although 3-PBS is the first option among radionuclide techniques for evaluation of the skeletal system, and has high sensitivity, its specificity may be limited [1,2]. Planar scintigraphy must be combined with Single-Photon Emission Computed Tomography (SPECT) to increase specificity, however their diagnostic value is limited due to the poor accuracy in localizing increased uptake [1,2]. Hybrid Single-Photon Emission Computed Tomography/Computed Tomography (SPECT/CT) system was developed. SPECT/CT can improve the prognostic value of planar radionuclide techniques since it evaluates morphologic and functional information together [1,2]. Both scintigraphic and tomographic imaging can be performed in the same session without changing the patient’s position with SPECT/CT. Fused images are obtained by overlapping both images. By this manner, SPECT/CT shows actual anatomical localization of radiotracer uptake on planar scan, and differentiation of bone-soft tissue can be made. SPECT/CT increases diagnostic accuracy of scintigraphy with the evaluation of bone and soft tissue morphology with CT component. To sum up, SPECT component of SPECT/CT increases sensitivity, CT component increases specificity [4,5]. The use of SPECT/CT with bone scintigraphy and tumor imaging agents has become widespread in the evaluation of cancer patients [6,7]. But SPECT/CT has not been used frequently in orthopedic diseases and there is not an adequate evidence for evaluation of orthopedic pathologies [8,9].

In this review, we discussed the role of bone SPECT/CT for evaluation of the shoulder, elbow, wrist, hand, hip, knee, ankle and foot, and its clinical applications with examples from our cases.

**SHOULDER AND ELBOW**

The shoulder and elbow pain are common findings due to degenerative changes, tumoral or traumatic situations (Figure 1-3). These pathologies cause impairment of joints functions. CR, USG, and MRI are imaging methods are often used in shoulder evaluation. Bone scintigraphy can be used when other imaging methods are failed to achieve a diagnosis. Especially, it is useful for evaluation of the patients with shoulder pain in whom the findings of MRI suspected. It plays complementary role. The reports about use of bone SPECT/CT with Tc-99m MDP or HDP for the shoulder is limited. Recently, the number of patients who operated for shoulder prosthesis increased. Although there are limited studies on the use of bone SPECT/CT for the patients who suspected post-operative complication, the results are promising. Hirschman showed that SPECT/CT is useful for determining the loosening humeral, and glenoidal components in the patients with shoulder prosthesis and for the evaluation of the acromioclavicular joint osteoarthritis and also, the pain associated with subacromial impingement [10].

It is difficult to distinct the metastasis from the increased activity due to degenerative changes in the shoulder in the cancer patients with the WBS. SPECT/CT can reach the correct diagnosis by evaluating the bone morphology and making accurate anatomic localization for these patients. Although osteoid osteoma is rarely seen in the shoulder, it can occur in the coracoid process, the glenoid fossa, the body of scapula and acromion. SPECT/CT is very useful for localization and treatment planning of osteoid osteoma [11].

**HAND AND WRIST**

The diagnosis of hand, and wrist problems is difficult. The most common finding is pain. The exact localization of the pain

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**Figure 1** Tc-99m MDP bone scintigraphy of 60 years old woman with right shoulder pain for two months. (A) Minimal focal radiotracer uptake is seen on the right acromioclavicular joint in anterior late static image (arrow), but (B) posterior late static image does not show increased osteoblastic activity in same localization. (C) In the axial CT and SPECT/CT images the medullar sclerotic rim is seen on the caput humeri associated with focal increased uptake (arrows). These fusion images are suggested benign bone pathology. (D) MRI revealed a 10 mm. hyperintense lesion on the caput humeri as suspected enchondroma (arrow). The patient is followed up. In this patient, bone SPECT/CT confirms the accurate diagnosis of lesion which is found by MRI. Also, WBS provides to evaluation of possible other lesions in whole body bones.
may not be done clinically as a result of many joints, intrinsic and extrinsic ligaments, tendons and small bones located in the hand and wrist. Radiological imaging methods are usually needed for diagnoses. Conventional radiography is the first imaging choice. If radiography is not beneficial, CT and MRI are suggested. Morphological changes in the carpal bones can be shown with CT.

The most important advantage of MRI is to detect the changes of the joints, soft tissue around the joint, and bone marrow oedema in the early stages. However, these imaging techniques’ success is limited in diagnosis of metabolic diseases. Bone scintigraphy allows evaluating the hand and wrist metabolic disease. PBS has a difficulty in localization of increased pathologic radiotracer uptake.
uptake due to complex anatomy of wrist. SPECT/CT is more valuable for the evaluation of the patients with pain in the wrist and hand than PBS. Florion reported that SPECT/CT detected 20% more lesions compared with CR and PBS [12]. Huel have demonstrated that providing high interobserver agreement when bone scintigraphy interpreted with the SPECT/CT [13]. In particular, SPECT/CT plays an important role in the detection of occult fractures which cannot be shown with other imaging methods, in the pursuit of post-traumatic bone healing, in making the precise localization of the increased focal radiotracer in PBS (Figure 4). Allinment reported that SPECT/CT is better to distinguish occult fracture in the wrist compared to CT [14].

Ulno-carpal region is frequently affected by the trauma and degenerative diseases. SPECT/CT allows to distinguish ulnocarpal impingement, carpal tunnel syndrome and Kienbock’s disease [15,16]. Early diagnosis of Kienbock’s disease is important to prevent permanent damage formation. When the result of radiography is negative and MRI is suspicious, bone SPECT/CT plays an important role in early diagnosis [16]. Metacarpal joint disorders, occult fractures, and lesions such as ganglion cyst of the carpal bones give similar results in the PBS. However, accurate diagnosis is very important due to difference in their treatments. Also, SPECT/CT has a great benefit in evaluation of inflammatory diseases such as rheumatoid arthritis and psoriatic arthritis.

The most important disadvantage of MRI is metal implants, after the hand and wrist surgery. Metal artefacts cause poor image quality. Bone SPECT/CT is sufficient for the evaluation of hyperdens bone structure despite of metal artefacts and it is useful for detection of post-surgical changes and complications.

The combination of CT arthrography and SPECT/CT called SPECT/CT arthrography is an effective method that can be used to display ligament and cartilage structure in the carpal region. This new imaging modality can be beneficial for the patients with ulnar impaction syndrome. SPECT/CT arthrography allows the visualization of scapholunate and lunatruquetral ligaments [17]. Consequently, SPECT/CT should be used as complementary method in hand and wrist disorders when MRI is equivocal.

**HIP**

Much hip pathology may cause pain and disrupt the function of the joint. The osteoarthritis is an important pathology of the hip. Arthroplasty is widely treatment choice preferred for osteoarthritis of the hip. The clinical results of the total hip arthroplasty are satisfactory in most of the cases, but several complications such as infection, aseptic and septic loosening, intraoperative fracture and heterotopic ossification may be seen. Loosening and infection are the most common complications [1-3]. Loosening in acetabular and femoral component occurs in approximately 10% of patients, and infection in 1-2% of the patients [19]. CR is the first imaging modality used in the evaluation of complications. However this method is not both sensitive and specific. CT and MRI are useful in the evaluation of the position of the prosthesis, bone structures and surrounding soft tissues, but noise is caused by metal limits their use.

3- PBS is the most commonly used method for the evaluation of hip prosthesis. The increased periarticular activity has continued for at least one year in bone scintigraphy due to remodelling of bone after operation. This period may be longer in some patients with cementless prostheses up to 2 to 3 years [1,18,20]. To distinguish loosening from infection and early diagnosis are very important, because treatment options are different. It cannot always be easy to distinguish loosening from infection with PBS. SPECT/CT has an important role in evaluation of hip pathology.

**Figure 4** A 58 year-old woman with suspected infection after distal radius fracture 2 years ago. She has wrist pain, swelling and erythema. Three phase bone scan is performed to confirm the infection. (A) Blood pool phase shows hyperemia in the wrist and (B) late static image shows focal radiotracer uptake in the distal radius. (C) Axial CT (D) fusion SPECT/CT images reveal intense increased activity in the distal radius and corresponding to the lower of fixator. Acute infection of around the fixator is confirmed by bone SPECT/CT. Antibiotic therapy is started. In this patient, MRI is not useful because of metal artifact.
prosthetic complications. However, the number of publications on this subject is limited. Strobel reported that SPECT/CT with PBS is promising for the evaluation of arthroplasties [21]. Tam recommended that SPECT/CT should be performed for the correct interpretation of the PBS in hip prosthesis complications [22]. In our study, we found sensitivity as 77% for PBS, as 93.7% for SPECT/CT in the evaluation of hip and knee prosthesis [23]. We revealed that SPECT/CT increased the diagnostic accuracy of the prosthesis complications, by making the actual anatomical localization of the increased activity in bone scintigraphy and identifying morphological changes in the bone structure and surrounding soft tissue (Figure 5). Bone and soft tissue changes obtained by CT component, such as prosthesis malposition, osteolysis, periprosthetic radiolucency, fractures, calcification, abscesses, oedema, fistula, accumulation of fluid in the joint contributed significantly to distinguish the loosening from the infection. According to meta-analyses, sensitivity and specificity of bone scintigraphy for aseptic loosening of the femoral component are 72%, 85% and for the acetabular component 67%, 83%, respectively in hip prosthesis [24,25]. According to the results of our study, SPECT/CT is more useful to detect loosening of acetabular component when it is compared to femoral component (sensitivity for acetabular component; 57.8% versus 89.4% and sensitivity for femoral component; 93.1% versus 94.1%) [23]. Acetabular region is exposed to the mechanical trauma due to rubbing of the caput femoris. Increased radiotracer uptake may be seen in the acetabular region due to mechanical trauma. Differentiating loosening of acetabular component due to mechanical trauma is difficult with PBS and SPECT. SPECT/CT can distinguish mechanical trauma from loosening owing to its ability to demonstrate anatomical localization.

MRI is the first imaging modality of choice the diagnosis of avascular necrosis. When it is contraindicated in patients who have fracture and metallic implant-fixation material in the femoral head or it is inadequate, SPECT/CT has an important contribution in these cases (Figure 6). SPECT/CT increases the diagnostic accuracy of PBS and SPECT. Agarwal was found diagnostic accuracy (95%), sensitivity (98%), and specificity (87%) of SPECT/CT [26]. Stress fractures and osteoid osteoma are other pathologies of the hip, SPECT/CT is reported to be beneficial for them [27].

KNEE

Knee pathologies are commonly seen and the most common symptom is pain. CR is the first preferred method in the evaluation of knee pathology as well as in the hip. MRI is generally required for evaluation of meniscuses, ligaments, cartilage and...
Figure 6: 39 years old men who has bilateral hip pain for three months and suspected avascular necrosis with findings of MRI. Three phase bone scan is performed to determine the stage of avascular necrosis. (A) There is no pathologic uptake in blood pool images. (B) Late anterior static image shows mild (thin arrow) and slight (thick arrow) focal increased radiotracer uptake in the bilateral hip. (C) Axial and (D) coronal SPECT/CT images show intense focal increased radiotracer uptake in both femoral head (arrows). These findings are interpreted as intermediate phase of avascular necrosis. The patient will be operated. Bone SPECT/CT completes MRI findings and manages the patient therapy.

Bone structures. Radionuclide methods play a complementary role in cases which MRI cannot be done and/or equivocal [1]. Bone scintigraphy and SPECT/CT are used in the evaluation of osteoarthritis, osteochondral lesions, osteonecrosis, painful knee prosthesis and bone tumors (Figure 7).

As for the hip, 3-PBS is the first choice radionuclide technique for the evaluation of painful knee prosthesis. After the knee prosthesis surgery, periprosthetic physiological activity generally continues up to 1 year. Sensitivity and specificity of 3-PBS are between 88%-92%, 76-100% respectively for the evaluation of loosening and infection [28].

Adding SPECT/CT to PBS provides information about the position of the prosthesis, morphological changes in the bone structure and surrounding soft tissue as in hip.

In studies of Hirschmann SPECT/CT contributes to the determination of the diagnosis of prosthetic malposition, patellofemoral pathology and loosening in 83% patients with painful knee prostheses. SPECT/CT allows high intra-interobserver agreement [29]. Al Nabhani determined that SPECT/CT confirmed the diagnosis in 21 of 24 patients who underwent knee prosthesis revision surgery, and distinguished aseptic loosening from infection and patellofemoral arthritis [30]. Also evaluating three compartments of the knee joint (femoropatellar, medialfemorotibial, lateralfemorotibial) with bone SPECT/CT provides important information for the decision of unicompartmental or total arthroplasty, and patellar resurfacing addition to the procedure.

The activity of osteoarthritis is very important for planning treatment. There is no relation between the activity of osteoarthritis and morphological changes. Therefore, radiologic imaging techniques are not useful for the evaluation of the osteoarthritis activity. But, it can be interpreted the activity of osteoarthritis looking at the intensity of increased activity detected by bone scintigraphy. In the study of Hirschmann showed more accurately activity and prevalence of osteoarthritis by adding SPECT/CT to bone scintigraphy [29].

Recently, the use of the SPECT/CT arthrography for knee has increased the value of SPECT/CT. This technique is particularly useful in scanning after intraarticular radionuclide treatment [31]. Chew used the SPECT/CT arthrography to evaluate the loosening of prostheses in hip and knee. They found that SPECT/CT arthrography is superior to the planar images in the loosening of the acetabular component. Although this method was superior in detection of loosening of the tibial component, statistically significant difference was not found [32].

SPECT/CT provides important information on diagnostic accuracy, and extension of benign and malignant tumors such as osteoid osteoma, enchondroma, osteoblastoma, giant cell tumor and osteosarcoma of the knee. It plays an important role in the detection of multifocal localization and distant bone metastases when combined with whole-body scan [1,4].
FOOT AND ANKLE

The diagnosis of the foot and ankle diseases is difficult clinically, due to small bone structures and complex multiple joints. The most common symptom is pain. Primary diagnostic methods in foot and ankle diseases are clinical examination and CR. USG, CT or MRI can be performed for differential diagnosis. MRI and USG have advantages in soft tissue but low specificity for bone pathologies [33]. CT can be illustrating bone pathologies, but it cannot give information about the activity of the pathology. 3-PBS is frequently used to evaluate the activity of foot and ankle bone pathologies. Adding SPECT/CT to 3-PBS provides important clinical information for evaluating in particular diabetic foot infection, inflammatory and traumatic diseases, degenerative diseases, accessory sesamoid bone, osteochondrosis dissecans and osteoarthritis. It plays an important role in the selection of treatment modalities such as corticosteroid injection or arthrodesis [1]. SPECT/CT changed the treatment plan in 78% of 39 patients with foot pain according to a study which was done by Singh. They reported the accuracy, sensitivity, specificity, positive and negative predictive values of bone SPECT/CT as 94%, 95%, 83%, 98%, and 71% respectively [33]. SPECT/CT is useful for the pathologies of foot and ankle to be treated by surgery. Claassen showed high accuracy for the decision of surgical treatment of foot and ankle with SPECT/CT especially in Chopart and Lisyranc joint [34]. Also Chicklor reported that bone SPECT/CT was beneficial for the most common causes of chronic foot and ankle pain as impingement syndrome and soft tissue pathologies [35].

SPECT/CT can be used for follow-up of the changes after the arthrodesis made for pseudoartrosis, subtalar joint osteoarthritis, and the healing of the calcaneal fracture (Figure 8). Pagenstent reported that it is very important to make accurate localization of osteoarthritis in the complex joints regions such as foot and ankle for planning the effective treatment and the selection of patients needed surgery [36].

SPECT/CT is the ideal imaging model for the detection of osteoid osteoma which is rarely seen in the foot bones. The nidus and increased activity on the lesion can be shown at the sometime supporting the diagnosis of osteoid osteoma. MRI may difficult to distinguish the nidus from the small tarsal bones due to intense bone marrow edema [37].

SPECT/CT arthrography provides evaluation of the joint cartilage, synovial changes and joint structures just as wrist and knee. SPECT/CT arthrography provides important information about bone metabolism, joint cartilage and the stability of osteochondral lesions after treatment, especially for osteoarthritis of ankle and osteochondral lesions of talus. Achilles tendinitis, plantar fasciitis and stress fractures are particularly common injuries of long distance runners. Clinical examination, USG, and MRI are successful methods for diagnosis. SPECT/CT has also been shown to be successful in the differential diagnosis of these pathologies. Stress fractures are not rarely seen pathology of foot and most frequently seen in 1-2.metatarsal bones. Stress fractures of the metatarsal and
sesamoid bones are usually determined by the PBS. However, the exact anatomic localization of activity cannot be done. It is very important to distinguish stress fractures from degenerative diseases and osteochondrosis dissecans, because of their treatments are different. Stress fractures appear as increased uptake in the fracture line or hyperdense areas on SPECT/CT images. In addition, separation of new and old fractures can be done with SPECT/CT.

Plantar fascia extends between tuberositas calcanei and the heads of the metatarsal bones and supports the arch of the foot. Plantar fasciitis is the inflammatory changes and ruptures that occurs due to micro trauma or overuse of the plantar fascia. It is often seen as a focal increase in activity in tuberositas calcanei in bone scintigraphy. This finding also occurs in stress fractures in calcaneus. SPECT/CT plays an important role in distinguishing the plantar fasciitis from stress fracture [2,37].

SPECT/CT can easily make the differential diagnosis of pathologies as ostrigonum or accessory navicular bone that cause pain.

Tarsal coalition is a deformity caused by bridging of fibrous, cartilage or bone tissue between two or more tarsal bones. Sometimes calcaneonavicular and talocalcaneal coalition cannot be noticed with CT or even with MRI [37]. Combining metabolic and morphological data with SPECT/CT and comparing with the other side is very useful in these patients.

There are several studies about reporting the role of SPECT/CT for diagnosis of osteomyelitis (OM) and diabetic foot. Horger investigated the value of bone SPECT/CT in patients with suspected bone infections. They found that specificity of SPECT/CT was significantly higher (50% to 86%), while sensitivity of PBS+SPECT and SPECT/CT was similar (78%). They reported that SPECT/CT improves the diagnostic accuracy of 3-PBS and reduces false-positive or suspicious results in the patients with suspected OM [38]. Diabetes mellitus and peripheral arterial disease increases the probability of OM especially in foot. 3-PBS is a beneficial method for accurate diagnosis and treatment in the patients with diabetic foot infection. The addition of SPECT/CT is very useful in the differential diagnosis of the OM and soft tissue infection and actual anatomic localization of OM in small bone structures. Heiber evaluated the diabetic foot and OM with dual isotope Tc-99m MDP bone scan and Indium-111 (In-111) labelled leukocytes SPECT/CT imaging [39]. They found that dual isotope SPECT/CT provides significant improvement in the differentiation of the OM from soft tissue infection compared with planar studies. To differentiate acute OM from chronic active OM accurately is difficult with 3-PBS since their scintigraphic findings are similar, but it is very important since their treatment options. Morphological findings are obtained by SPECT/CT provides an important contribution to the differential diagnosis of chronic infection and the acute infection. SPECT/CT demonstrates morphological changes of soft tissue (soft tissue edema, abscess, fistula tract, etc.) and bone (cortical destruction, sequestration, involucra, etc.) associated with increased tracer uptake [3,38].

**THE LIMITATIONS OF SPECT/CT**

The limitations of SPECT/CT are the high radiation dose and cost. Patients with suspected pathology in the extremities often require several radiologic imaging modalities as X-Ray, diagnostic CT before the correct diagnosis can be. Radiation exposure dose of radiologic methods is much more than the SPECT/CT [29,40]. SPECT/CT studies increase radiation exposure compared to planar bone scan and SPECT. SPECT/low dose CT is associated with low radiation dose such as 1-4 mSv with a single bed position (FOV=40 cm). SPECT/low dose CT is usually sufficient for the diagnosis of pathology and for anatomic localization, but

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**Figure 8** 46 year-old woman patient who has right ankle pain for 6 months is performed bone scintigraphy. She has history of no trauma to the right ankle and foot. X-Ray is normal. (A) Anterior and (B) lateral planar late bone images show focal increased osteoblastic activity in the right ankle (arrows). (C) Axial and (D) sagittal SPECT/CT images show fracture of the anterior of the right talus with increased focal radiotracer uptake at the fracture site (arrows). The patient is confirmed as fracture with MRI. Bone SPECT/CT shows the viability fracture line with increased metabolic activity.
sometimes there is need for more spatial resolution, and high image quality for evaluation of morphologic changes. Especially, the evaluation of small bone structures in the foot, and hand are difficult with low dose CT. The accuracy of SPECT/CT images might be increased by replacing low dose CT with spiral multi-slice CT. Nowadays, spiral multi-slice SPECT/CT is already commercially available. But high radiation dose of SPECT/multi slice CT such as 6-14 mSv shouldn’t be ignored [40]. We use SPECT/low dose CT (Millennium Hawkeye 4GE Medical Systems, Milwaukee, WI) in our department. The images presented in this review are taken with low dose CT.

Cost effectiveness of SPECT/CT when compared to other imaging modalities is not definitely put forward yet. However, SPECT/CT can decrease time for initiating treatment, anxiety of patients, prevent unnecessary treatment and hospital visits, and additional laboratory/ radiological investigations. Considering those results, cost of SPECT/CT may be ignored. Therefore, SPECT/CT should be preferred particularly in patients with confusing bone scan findings.

CONCLUSION

Three phase bone scan is the first choice technique among the radionuclide procedures for the evaluation of patients with suspected pathology on extremities and joints. Planar images combined with SPECT/CT are useful tool in diagnosis of these pathologies. SPECT/CT can change the diagnosis and management option of the patients due to correct anatomical localization of radioactive uptake, and evaluation of bone-soft tissue morphological changes. SPECT/CT plays a supplemental role in suspected cases which exact diagnosis cannot be done with CR, CT and MRI. Fusion images increase the specificity of planar bone scan in the compact joint and small bone structures as wrist, hand, foot, and ankle. SPECT/CT seems to be an encouraging method for diagnosis and evaluation of extremities.

REFERENCES


