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^{18}F-Sodium Fluoride (NaF) Imaging on Ultra-High-Resolution Positron Emission Scanner: Example of Textitis

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ABSTRACT

Textitis is a new term used for osteoarthritis, the degenerative strain disease that comes from excessive smart phone usage. ^{18}F-NaF is increasingly used in diagnosing skeletal pain which not identified on radiographs. We report a case of 26-year-old woman with left breast cancer referred for ^{18}F-NaF PET-CT. She is complaining of right thumb and wrist pain. Findings are negative for bone secondaries. Dedicated hands views are acquired on positron emission scanner which shows focal uptake at 1st carpometacarpcal and 2nd metacarpophalangeal joints. Based on the strong history the findings are likely due to active arthritic changes due to repetitive strain injury caused by excess text messaging (textitis).

Introduction

Textitis is a new term used to describe a kind of osteoarthritis, the degenerative strain disease that comes from excessive smart phone usage. Smart phone users are at risk of developing various repetitive strain injuries (RSI) to the soft tissues due to repetitive use of the phone for text messaging (*1*). Although trauma, osteoarthritis, rheumatoid arthritis can also present similarly however in current patients the symptoms of pain, tenderness, throbbing, tingling or numbness and weakness were strongly associated with extensive texting (*2*). Texting thumb pain can be due to strain in the tendon due to constant holding of a cell phone or stretching of the thumb to type text messages. Pain can also be due to arthritis at carpometacarpal joint where the wrist and thumb are joined (*3*).

Usually no radiological tests are advised for mild symptoms however for moderate to severe pain a radiograph is usually recommended to rule out any under lying pathology. Treatment of RSI include activity modification, pain killers, cock-up wrist splints, and limitation of texting. But without treatment, the symptoms become constant and causing swelling in the affected area.

Case report and methods

We here report a case of incidental findings of texitis in a 26-year-young lady a known case of left breast cancer referred for ^{18}F-NaF PET/CT for staging. 3.9mCi (0.06mCi/Kg) of NaF was injected followed by whole body images acquired 60 minutes' post injection and dedicated hand images were acquired for 10 minutes. Imaging parameters and reconstruction was followed as per local protocols (Table 1) Whole body images were negative for bone secondaries however patient was

complaining of pain at right thumb and radial aspect of the wrist. Dedicated hand views show focal uptake (figure 1-A) at 1st carpometacarpal, trapezium-scaphoid and 2nd metacarpophalangeal joints. Findings when correlated with history of excessive mobile use favor active arthritic changes due to repetitive strain injury caused by excess use of smart phone for text messaging (textitis). The institutional review board approved this study and the patient signed a written informed consent for use of her data for publication.

Discussion

In the era of advanced technology many young persons are at a higher risk of developing RSI. There are no current recommendations of routine use of radiological modalities for suspected RSI and the patients are managed conservatively. In our case the young lady was a known case of breast cancer who underwent routine staging bone scan with Sodium Fluoride PET/CT. ^{18}F-NaF is an excellent bone-seeking agent owing to high bone uptake due to rapid single-pass extraction, minimal binding to serum proteins, and fast clearance from the soft tissues. Encouraging results have also been reported for its use in characterizing benign bone diseases and enthesopathies (*4*).

Positron emission mammography (PEM) technology is currently used for breast specific metabolic imaging. It has superior count sensitivity and high spatial resolution (up to 2 mm). At our department, we have a dedicated PEM scanner, dual-headed coincidence detector to produce limited-angle tomographic (LAT) images. The detectors are mounted on an articulating arm which allows images to be acquired in any orientation, e.g. craniocaudal and mediolateral. The lower (support) paddle is fixed to the arm while the upper (compression) paddle is adjustable to provide mild

compression (15 lbs of force) and can be moved up to 20 cm from the support paddle (table 1). The enclosure is light-tight and EMI-tight. Additionally, the enclosure is 95% tungsten on 5 sides to shield the detectors from radiation outside the FOV. The entrance window is 1-m thick aluminum to maximize transmission of annihilation photons from within the FOV. Each detector head houses a 2 × 6 matrix of detector modules, each of which comprises a crystal array, a reflective light guide and a position-sensitive photomultiplier tube (PSPMT). Individual crystals (2 × 2 × 12 cm3) of LYSO are packed in 13 × 13 arrays with a crystal pitch of 2.1 mm (*5*).

PEM is a small portable device that can be used to evaluate difficult to image, peripherally located lesions. Scarce data report the utility of ^{18}F FDG using PEM to image the lesions outside the breast or in extremities (*6*). To our knowledge this is first case using ^{18}F-NaF on dedicated positron emission scanner for bone imaging for peripheral regions with example of repetitive strain injury to thumb due to excessive text messaging. Due to superior spatial resolution PEM may help to play a role in the imaging of small bones or joints, such as those of the hands. However, of important note, such findings may co-exist with underlying pathological arthritis, old trauma, rheumatoid arthritis and tenosynovitis but careful history and clinical examination can lead to precise interpretation as in our patient there was no prior history of any bone related disease.

Conclusion

In the presence of high resolution PEM technology using highly sensitive bone agent i.e. ^{18}F-NaF, it was possible to image minute degrees of strains in the small bones. Current scenario highlights the significance of these twin technologies in evaluation of

musculoskeletal disorders of small joints which may potentially be used in evaluation of more prevalent joint disorders i.e. rheumatoid arthritis, especially for their post treatment response assessment.

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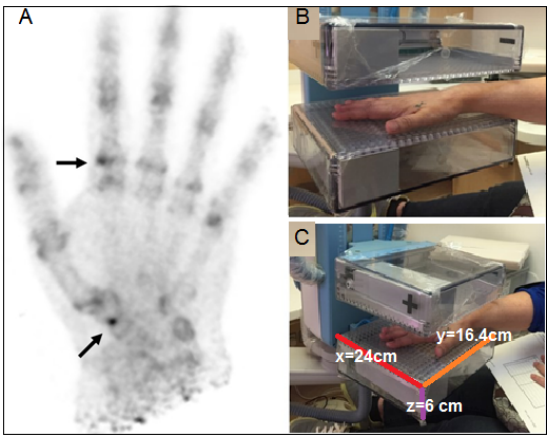

Figure 1: A) MIP images of the hand showing focal increased tracer activity at 1st carpometacarpal, trapezium-scaphoid and 2nd metacarpophalangeal joints (black arrows). B and C show The GE™ Naviscan positron emission mammography (PEM) scanner.

Table 1: Technical parameters of the PEM camera (*5*)

Acquisition	
Views	Anterior posterior mage of the hands Anterior posterior mage of the feet
Field-of-view (x-y plane)	24 × 16.8 cm^2 (maximum)
FOV (z-direction)	Patient dependent (maximum up to 19 cm)
Compression force	≤ 15 lbs for breast, Patient dependent for hands and feet view
Scan duration	Variable (typically 10 min)
Reconstruction	
Coincidence timing window	6 ns
Energy window	350 – 750 keV
Acceptance angle	25 crystals. Angle varies with paddle separation
Algorithm	Iterative 3-D Maximum Likelihood Expectation Maximization
Number of iterations	5
Corrections	Detector normalization, geometric efficiency. NO corrections for randoms, dead-time, attenuation, scatter or intrascan decay
Reconstruction time	Depends on number of counts (typically < 15 min)
Images	
Image matrix	136 × 200
Pixel size	1.2 × 1.2 mm2
Resolution	2.4 mm FWHM
Number of slices	12
Slice thickness	1/12th detector separation
Units	μCi/cc or PEM Uptake Value (PUV)