Imaging avascular necrosis of bone: "The shifting paradigm"

An excellent original article entitled "F-18 fluoride PET-CT bone scan in the diagnosis of avascular necrosis of the femoral head-comparison with MRI" published in the current issue of Indian Journal of Nuclear Medicine highlights an attractive evidence based option in an otherwise grey area of imaging to diagnose avascular necrosis (AVN) of bone. The study based on 51 consecutive patients with high clinical suspicion of femoral head avascular necrosis (FHAVN) from a leading tertiary care hospital of India is well conceived and has a reasonably good study design. The authors' report on a perfect 100% sensitivity, specificity, and accuracy for positron emission tomography-computed tomography (PET-CT) can be to some extent attributed to a patient selection bias since most of them had a high clinical suspicion of FHAVN. The initial encouraging results will need more validation before F-18 sodium fluoride (NaF) bone PET-CT becomes the bench mark in imaging of clinically suspected AVN in bone including that of the femoral head. AVN of bone or Osteonecrosis is characterized by cellular bone death due to the interruption of its blood supply, as a result of which the involved bone becomes nonviable resulting in pain, structural collapse, and residual disability. Being asymptomatic, most patients in the initial stages remain under diagnosed and progress to destructive arthropathy requiring major surgical procedures. The disability invariably has both functional and economical consequences.[1] An early diagnosis is a key to minimize the consequences of AVN, and this requires a high degree of clinical suspicion in an appropriate clinical background. The prompt diagnosis followed by measures to preserve the structural integrity of the involved bone or joint particularly the hip joint has a better prognosis in younger patients who otherwise have relatively poor results with joint replacement therapy. In the United States of America, an annual expenditure of $1 billion is incurred on a total hip replacement for underlying AVN of the femoral head. AVN of bone usually involves epiphysis of long bones such as femur and humerus but smaller bones such as lunate, scaphoid, and talus may also be affected. In the day-to-day clinical practice, AVN commonly affects the hip joint (femoral head) leading to pain and functional difficulties. Despite extensive investigations the cause of FHAVN remains unknown, its association with various clinical conditions such as alcoholism, steroid excess, trauma, decompression sickness, sickle cell disease, Gaucher's disease, embolic disorders, and autoimmune vasculitis, etc., are well documented in medical literature.[2] Rarely patients taking bisphosphonates have AVN of the mandible.[3] Lately, the patients treated with denosumab, a human RANKL monoclonal antibody used for the treatment of osteoporosis, rheumatoid arthritis, and metastatic bone cancer have also been reported to have AVN of the mandible.[4] In a published study from Romania based on a study group of 92 patients diagnosed with AVN of femoral head the main associated risk factors were smoking (36.96%), alcohol intake (20.65%), trauma (11.96%), and corticosteroid therapy (8.70%). In 29.35% of patients, no risk factor was identified.[5] In 54–80% of renal transplant recipients in whom AVN of the femoral head is detected on conventional plain radiographs, the involvement is bilateral. Availability of state of the art sensitive and specific imaging modalities such as Tc-99m methylene diphosphonate (MDP) three phase bone (TPB) scintigraphy, single-photon emission computed tomography (SPECT), computed tomography (CT), SPECT-CT, and magnetic resonance imaging (MRI) have relegated the role of conventional radiography in diagnosis of AVN to a historical status. Which out of this, niche imaging technology becomes the modality of choice is still a matter of open debate and more scientific validation? On comparative analysis based on published data, TPB scintigraphy with Tc-99m MDP and CT imaging are reportedly less sensitive for picking up early stage AVN of femoral head while SPECT-CT and lower magnetic field MRI (<1 T) are comparable. A high magnetic field (more than 1–1.5 T) is more effective in diagnosing early stage FHAVN in comparison to SPECT-CT.[6,7] On scientific thinking, the hybrid imaging modality of F-18 NaF bone PET-CT seems to have compelling theoretical rationale and practical appeal to emerge as the future imaging choice for early diagnosis of AVN of bone particularly the debilitating AVN of femoral head. The fusion imaging will incorporate the inherent advantage of F-18 NaF bone PET like its high bone uptake and faster background clearance providing an excellent target to nontarget contrast resulting in a better spatial and contrast resolution. A shorter imaging time also makes it more comfortable. The precise anatomical localization of avascular region and the other associated morphological changes is achieved with the high-resolution CT component of the equipment. Radiation exposure and related safety issues though addressed to a great extent in newer equipment models still continue to be matters of concern while advocating PET-CT hybrid imaging in clinical practice. The issues related to economical affordability may sometimes prove to be a stumbling block. In the fast shifting paradigm of hybrid imaging in AVN of bone particularly the femoral head F-18 NaF bone PET-CT on account of its excellent image qualities is likely to emerge as the modality of choice in early diagnosis of AVN of bone in general and femoral head in particular. In patients with indeterminate findings on F-18 NaF bone PET-CT and in situations where radiation exposure

needs to kept to a minimum F-18 NaF bone PET-MR can be an alternate imaging choice.

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