When and What is Radioimaging / Nuclear Scan for Foot Complications in Diabetes?

Prof Ketan Dhatariya MBBS MSc MD MS FRCP PhD

Consultant in Diabetes and Endocrinology

Norfolk and Norwich University Hospitals

Disclosures

- None
- But I’m a foot doctor, not a radiologist!

To Start With

- Let's get the 'obvious' things out of the way
- The initial imaging of the diabetic foot should almost always be a plain, weight bearing X-ray
- MRI (if available) is the gold standard modality for most foot complications

Technical Factors

- Interpretation of any images are dependent on their quality, appropriateness of the projections requested and performed)
- The interpretive skills of the observer – the carer for the wound will know more than the radiologist)

Technical Factors

- Knowledge of the clinical state of the wound and the patient
- Knowledge of other test results – e.g., bloods
- Knowledge of previous imaging (especially if digital images are kept)

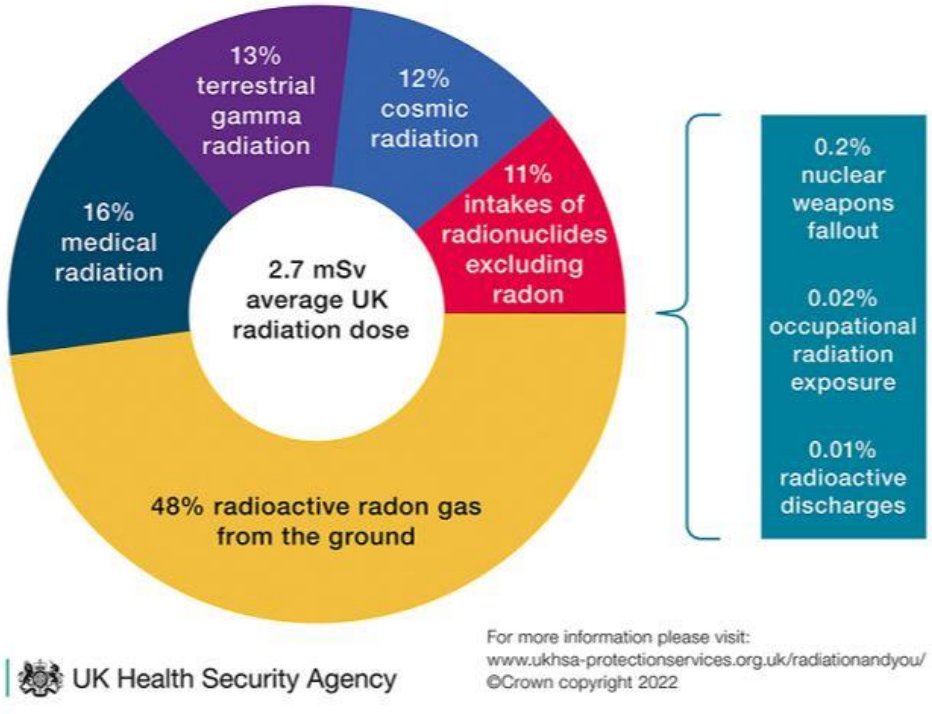
Radiation Exposure

- A single foot X-ray is usually <5µSv
- UK and Indian background radiation exposure is ~2.7 and 2.4mSv respectively per annum (but as high as 12.5mSv in Kerela)

https://www.ukhsa-protectionservices.org.uk/radiationandyou/
https://www.aerb.gov.in/english/background-natural-radiation

Where Does that Come From?

Perspective of Doses
All Values in Micro-Sievert
Threshold for Mortality 2,000,000
Radiation Sickness Appears 1,000,000
First Signs of Radiation Effects 500,000
Emergency Worker Dose Limit/yr 250,000
Risk of Health Effects insignificant 100,000
Thyroid Scan 43,000
Thallium Cardiac Stress Test 36,000
Occupational Dose Limit/yr 30,000
One Chest CT Scan 7,000
Natural Background/yr 2,400
Public Dose Limit/yr 1,000
One Chest X-ray 100
One 10 hr. Air flight 50
Actual Annual Radiation Dose from Operation of NPPs at Exclusion Boundary < 15



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Plain X-rays

- If a fracture, Charcot, or ulcer (±osteomyelitis) is demonstrated, then further imaging can be tailored as necessary

- 5Ds of Charcot on X-Ray
  - Density, debris, distention, disorganization, dislocation

But

- The images of OM on plain X-rays may lag 2 – 3 weeks behind what is happening in the foot – particularly when considering osteoid (de)mineralization (so serial X-rays are helpful)
- Co-morbidities may complicate interpretation
  - Gout / OM / Charcot

Newer Techniques

- CT, MRI, PET, labelled white cell scans, fusion scans may all help, but compared to plain X-rays
  - Cost more
  - Have lower availability
  - Have no greater sensitivity or specificity for most foot pathology
  - Higher radiation dose (excluding MRI)

Other Imaging Modalities – US

- Portable
- Cheap
- No radiation
- Good for identifying
  - Fluid collections (differentiation between oedema, cellulitis and abscess) joint effusions, foreign bodies, tenosynovitis, degree of PAD (doppler), and guiding intervention

Other Imaging Modalities – CT

- Commonly available
- Relatively inexpensive
- But radiation exposure
- Good for identifying
  - Subtle bony erosions, osteopenia, malalignments, soft tissue collections (especially with contrast), calcification, bony sequestrum and foreign bodies

Other Imaging Modalities – MRI

- Less commonly available
- Expensive
- But no radiation exposure
- High specificity and sensitivity for identifying
  - Standard of care for joint, soft tissue and bone marrow changes (OM vs marrow oedema)
  - Early Charcot

Other Imaging Modalities – Scintigraphy

- ^{99}Tc, ^{111}In, and ^{67}Ga scans provide physiological information
- Only modest NPV or PPV
- Used less often because a positive technetium bone scan does not significantly increase the likelihood of disease, while negative ones do not significantly decrease it

Other Imaging Modalities – Scintigraphy

- Radionuclide imaging agents, such as scans using white blood cells (labeled autologous leukocytes), labeled immunoglobulin, or other infection-specific radiopharmaceuticals, are more specific than ^{99}Tc bone scans

^{99}Tc methylene diphosphonate

- In OM has >90% specificity and sensitivity of no other pathology is present – but drops quickly if there is
- Time consuming 4 phase studies – up to 24h

^{111}Indium Leukocyte Scan

- Useful in diagnosing infections
- Labelling cells is time consuming
- Examinations are lengthy – up to 24h
- False positives with fractures, surgery, Charcot metastatic disease,

Other Imaging Modalities – SPECT-CT

- Allows identification of inflammation on imaging to be linked to particular tissues with the anatomical precision of CT scanning
- Uses ^{67}Ga attached autologous white cells using ^{99}Tc before they are reinjected
- But time consuming, expensive and not widely available - and may not help compared to SoC!

In Summary

- Start with clinical assessment of the foot
- Appropriate plain X-rays
- If necessary, do a CT scan
- Scintigraphy is less useful
- But MRI is best in most circumstances

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www.norfolkdiabetes.com
ketan.dhatariya@nnuh.nhs.uk
@ketandhatariya
@ABCDiab
@JBDSIP