

2007 Oral (Therapy) Type – I

Areas covered:

- Radiation Protection & Patient Safety
- Patient Related Measurement
- Image Acquisition, Processing & Display
- Calibration, Quality Control and Quality Assurance
- Equipment

Radiation Protection & Patient Safety

1. One LINAC room. Write down the equation for primary beam shielding calculation. Explain each item. Calculate Workload, how do you define Unit factor, Occupancy factor. What is the difference between primary and secondary and leakage radiation, etc. Dose limit to different part?
2. A diagram three adjacent rooms for LDR. The left two has bed close to each other over the wall. The right one has bed farther away. Which is the best for LDR? What else should you consider for patient and nurse safety? (room, floor, visitor line, lead shielding on the patient bed edge, etc).
3. I-125 seed is dropped in the toilet. What do you do? 20 high activity seed dropped in the trash and are on the way to landfill, what do you do?
4. Stochastic and Non-Stochastic, what are they? Give examples? Spine belong to which category? Kidney dose tolerance, cornea?
5. HDR brachy room. How do you calculate the shielding? Write down the equation?

Patient Related Measurement

1. Three isodose for Electron/Photon field abutment. What is this about? What is a typical treatment using this arrangement? Which is best isodose? (middle one has more uniform dose; left hot spot; right cold spot). How do you improve it.
2. A stereotactic radiosurgery plan. How it is produced? What is the smallest and largest diameters for radiosurgery and why? What is difference between cone and MLC. In Archtherapy, MLC change the shape? Coplanar or Non-coplanar? What technology is used to produce the isodose line here?
3. Tandem and Ovoid diagram? What kind of Brachytherapy is this (HDR), what is the difference between this applicator and Fletcher-Suite LDR applicator? Point A, B, ICRU, Rectal Point, etc. How to prescribe dose? What is the normal dose to point B?

4. MU calculation formula for SAD setup (Khan 10.9), explain S_c , S_p , Inverse Square law; how to measure S_c , S_p ; why S_c increase with field size.
5. GafChromic Radiochromic film dosimetry (OD vs Dose). Explain the curve, compare with XV-film (range, energy response, etc).

Image Acquisition, Processing & Display

1. CT/MRI pictures of brain. what are these 2 pictures? Identify various parts (5 of them; cavity, optical nerve, etc).
2. CT/MRI fusion checkerboard. What are this? Why fuse CT with MR? What software do you use? How do you fuse the image?
3. PET/CT fusion. Why to do this? What material is used to generate the PET image. How do you register it, how do you know it is good registration? Resolution of PET? Where is the tumor on the graph?
4. Picture of a CT-sim. What is its characteristic compared with conventional Simulator? (Laser, Table). How do you generate DRR, can you get from conventional simulator?
5. Two images (DRR and port). What are these images? How do you use them? What if they are not compatible. DRR quality issues.

Calibration, Quality Control and Quality Assurance

1. TG-51 Electron curve for I50, R50, how to get E_p , E_0 . Effective point. How to get R50 from I50.
2. TG-51 Electron K_q factor. Why is it important? How do you get it; $K'(r50)$, $K(e_{cal})$, $P_{gradient}$.
3. HDR Calibration. Equipments needed for it; Write down the equation to get the exposure rate. What is sweet spot?
4. Three rotations for LINAC, what are they (gantry, collimator, couch). How do you check it, what is the tolerance, what is the protocol? What morning QA do you do, what is the output range to take action? Then how do you setup Monthly, Daily QA, etc.
5. New LINAC acceptance and commissioning. What are some important procedures? Orders?

Equipment

1. Picture of TLD system readout. How do you read them out? Materials? Energy dependent?
2. Diagram of a Klystron, What is this? Explain how it works? What are each part and process?
3. Cut away view of thimber chamber (Khan Fig 6.3). Identify 3 parts and their materials. How do they connect to triode cable. What is the volume normally?
4. CCD camera. Identify different parts in the graph.
5. Cone-beam CT. How does it work? Does the couch move while scan? What is the energy?

2007 Oral (Therapy) Type – II:

Shown a thin circular phantom with 5 holes and lots of plugs beside the phantom. What is it and for what purpose? How do you calibrate CT # and electron density? Why is it important? What other CT QA you need to do. Where to find reference on this topic? What would you do if you find the resolution is worse than commissioning?

Shown a Linac room with maze and isocenter location. Minimal dimensions required for 6x machine? For dual energy machine? How to put machine, console, AC duct, physics duct, HV cable? Shielding against what sources? How? Typical thickness?

Photos of a real Klystron unit and a Magnetron unit side by side. What are they? Principles, applications, pros and cons for each. Where is RF come from in each case?

Static, universal and dynamic wedge. What are they? How to commission? Acceptance test? Clinical application? Pros and cons of each.

Design of 200 mCi Cs-137 safe. Permissible doses? Typical thickness. Any difference if safe in hospital rather than in Department of radiation oncology?

Brain axial MRI and CT images. What type of MRI is it (T1 or T2)? What's the difference? Identify anatomical structures. How do you use them? Why use them? What accuracy in fusion do you accept? Can you plan using MRI.

TG-51 lead foil. Details about location, size, thickness. Two reasons for using it? What if you did not use it? How much error do you expect? At what energy do you need it? More about TG-51. I-131, Cs-131, Xe-131

What are isotone, isotope and isobar? Usage of them respectively.

3 field (AP + wedged lateral) plan on head and neck (nasopharynx) as in Khan's book. Why use wedge? Wedge angles? How to reduce dose to eye.

Cervix HDR brachytherapy. Which applicator? Volume to treat? Can you use Tandem alone? Can you use Tandem and cylinder? ICRU points. Typical dose to these points. Are they good representative?

Excel spread sheet of daily outputs for 3 electrons and 2 photons (5 value vs date curves). Why the mean values of the curves are different? What daily QA you need to do? Tolerance and Action level? What if the deviation is 3.2% or 4.8%? What do you check if the output is truly off by 7%?

IMRT: concept, delivery technique and planning procedure. General QA and Individual patient QA. Pros and cons vs. 3D.

prostate CT (axial, coronal and sag) with contours.

Identify structures. Concepts of GTV, CTV --- Treated volume as well as PRV. How much margin. Rx dose and tolerance dose for each. Typical beam arrangements: from two conventional techniques to IMRT.

90 degree magnet (Karzmark's book) Effects of E, position and angular shift. Details about how bending magnet works, 90 vs 270.

posting signs.

What posting required on your Linac door, HDR door, source room door, LDR door? What are the regulations?

Linac shielding layout

Typical workload. Give specific use factor and occupation factor at various places. Dose limits for various places.

Image registration and fusion.

Why? Different methods? Give example cases when fusion of CT/MRI, CT/PET are needed. Do you fuse ultrasound images?

3 electron field matching cases (abutting, small gap, large gap). I think one is 6e the other is 9e (?) Why different energy? Give clinical example. What happens in isodose lines in each case? Which case do you prefer? How to improve if you are not satisfied? How about electron and photon field matching?

flatness/symmetry

Definitions for electron and photon beams. Tolerance. How to measure? How often? What to do if it is beyond tolerance?

Portal film

What is port film? Why use port film? Which type of film do you use? How much MU do you give for this type of film? What is the patient dose due to port film? Should we include this dose in chart? What is CR? What is EPID? Do they require more MU or less MU?

2007 Oral (Therapy) Type – III

- There was a picture of an atom with a potential well shown below it. Question was what is this. There was no indication of whether the nucleons were protons or neutrons, but some looked like they might have had very fuzzy '+' in the middle. Discussion then went on to whether this would make a good MRI agent. The questioner was very understanding.
- Fuzzy picture of what turned out to be a frame for CT QA. What is it? I didn't have a clue (we farm out our CT QA) but I talked my way through it, said that due to the different thicknesses of lucite and registration marks on it it must be for calibrating some sort of x-ray device. Again, the questioner was very understanding.
- There were two pictures of electron scatter voxels, one in a white background and another in a darker background. Question was what is this. How is it calculated. How do different materials affect it. How does density affect it.
- Typical accelerator vault shielding question. You need to know how IMRT affects the shielding calculations.
- Schematic (I think from Varian) of an EPID. What are the different layers for, what is a FET.
- Picture of a resonant cavity. What is a resonant cavity, traveling wave. This was the only accelerator question I had.
- The schematic from the AAPM report of a diode (it's in Khan as well). Why the different orientations. What (or why) makes one design better for electrons and not photons.
- Question something like "as a locum physicist you are brought in to double check another physicist's output calibration and you find a big discrepancy. What do you do" At first I thought this was an ethics question but gradually it got into a discussion of TLD's.
- A question about expected dose rates near a LDR patient.
- A question about wedges. What do you use in your clinic (we use Elekta Universal). How do you measure wedge factor, how is it used in your hand calculations. Question drifted to Dynamic wedge, what is it, what are the advantages of using it.
- A question about HDR calibration. What is the equation, what does each factor mean. Where I work we do not correct for ionization recombination and the questioner and I got in an argument about this. I don't recall a Task Group dealing with the issue (might be a good continuing education project...)
- A question about TG-51. Very specifically how do you cross-calibrate a plane plate chamber.