AbstractID: 7183 Title: An Introduction to the Physics, Techniques and Radionuclides in the Intravascular Brachytherapy for the Treatment of Restenosis

Recent clinical trials have shown that intravascular brachytherapy (IVB) is effective in the treatment of restenosis, which occurs in 35%-40% of patients who underwent angioplasty in coronary vessels. In the treatment, radioactive source is inserted into blood vessel and placed at the location where lesions occur so that certain amount of radiation dose is delivered to the lesions. Unlike conventional brachytherapy in which target volumes are usually several centimeters in size, the treatment depth of IVB is usually in the order of millimeter. Furthermore, the lesions in IVB are usually much longer in longitudinal dimension and are more likely to be in cylindrical shape. Because of these factors accurate determination of dose distribution in IVB is much more difficult than conventional brachytherapy and the implementation of the IVB treatment is different from conventional brachytherapy both in techniques and in the choices of radionuclides. Various techniques have been developed for IVB. These delivery systems include catheter-based device, radioactive stent, impregnated radioactive balloon, radionuclide-filled balloon, and so forth. Dose distributions, both in the transverse and longitudinal directions, are different for different delivery systems even if same type of radionuclide is used. In general, the catheter-based delivery system offers the least steep radial dose gradient. Both photon emitters and beta emitters are used in IVB. Beta emitters are suitable due to the fact that target volumes in IVB are usually within the penetration range of the beta particles. For photon emitters commonly used in IVB, radial dose penetration does not change significantly within the range of 10mm. On the other hand, the radial dose penetrations of beta emitters are much more susceptible to the source positioning than photon emitters. In implementation of IVB, many other factors need to be taken into consideration for generating accurate dose distributions. Source off-centering, vessel curvature, vessel bifurcation, and high atomic number materials may potentially introduce signification dose deviations from prescribed dose. These perturbation effects are significantly different between photon emitter and beta emitter and are also dependent on energy of particles emitted from the radionuclides.

Educational Learning Objectives:

1. Describe the physics of intravascular brachytherapy and the techniques and radionuclides used in the treatment of restenosis.
2. Identify the dosimetry characteristics of photon emitter and beta emitter and the differences in dose distributions between the two types of emitter.
3. Identify the dosimetric characteristics of different types of treatment delivery systems and their clinical implications.
4. Analyze the dose variations in clinical situations and the dose dependence on source off-centering, vessel curvature, and vessel bifurcation.