Stent effect on beta dose distributions for intravascular brachytherapy

In the treatment of in-stent restenosis with intravascular brachytherapy, the influence of stent on the doses delivered to target tissues may be clinically significant. We have performed Monte Carlo dose calculations with and without stent for three beta isotopes, Y-90 (2.3MeV), Rh-106 (3.5MeV) and Pr-144 (3MeV), in the perpendicular bisector of each source. The stent struts (63.5 x 100 microns) are at 1.5 mm from the source and 18° apart. Three stent materials, steel, nitinol and tantalum, are studied. The stent factor, $s(r,\phi)$, defined as the ratio of dose with stent strut to that in the homogeneous water, was obtained as a function of radial distance, r, and azimuthal angle, ϕ. The scoring voxels were 0.1 mm in r and 2° in ϕ.

A dose reduction was seen behind the stent. For all three isotopes, the reduction right behind a strut was 15% for steel and nitinol, and 40% for tantalum. We also found dose enhancement right in front of a strut. The stent factors are 1.05 (steel and nitinol) and 1.2 (tantalum) for Rh-106 and Pr-144, and 1.1 (steel and nitinol) and 1.3 (tantalum) for Y-90. In the regions between two neighboring struts, dose enhancement is also noted, with s=1.1 for tantalum and 1.07 for steel and nitinol.

In conclusion, the dose reduction and enhancement due to the presence of stent are significant. We will discuss the stent effect for different strut spacing.