AbstractID: 2539 Title: Dose-volume modeling of treatment outcome

Since the landmark compilation of estimates of normal tissue partial volume tolerance doses and LKB model parameters by Emami et al. [1] and Burman et al. [2] in 1991, phase I dose escalation studies utilizing 3D conformal and IMRT techniques carried out in the last 10-15 years have provided quantitative data on dose volume dependencies of complication probabilities. For some organs the use of local and global function tests have provided data from objective endpoints which have been used to assess functional damage arising from irradiation of normal tissue. In concert with these developments, more rigorous statistical methods of model fitting and data analysis have been adopted. Improvements in our understanding of the dependence of complication probabilities on partial volumes of normal tissues irradiated will be described, including models for lung, liver, parotid, and rectal complications. Recent data from studies of radiation pneumonitis, including data suggesting variation in sensitivity of upper versus lower lung will be presented. Several limitations of current clinical data will be discussed: numbers for severe complications in single institution trials are usually small, and surrogate (lower priority) endpoints are often used, these have higher incidence and allow modeling with greater confidence, but are of less clinical relevance; use of fixed treatment techniques leads to correlations in values of dose-volume variables in the patient population, making discrimination between models difficult; effects of organ motion are difficult to remove post-facto and methods for accounting for them in outcome data in their infancy. To overcome poor statistics, merging of data from different institutions will be required. The difficulties of carrying out this task will be outlined.

[1] Emami B., et al., Tolerance of normal tissue to therapeutic irradiation. I.J.R.O.B.P. 21:109-122, 1991.
[2] Burman C., et al., Fitting normal tissue tolerance data to an analytic function. I.J.R.O.B.P. 21:123-135, 1991.

Educational objectives:

1) To understand the advances made in our knowledge of dose-volume dependencies of normal tissue complication probabilities (NTCP) in the past 10-15 years.
2) To understand the limitations of our current knowledge of NTCP, and future work necessary to overcome these limitations.