AbstractID: 9188 Title: Adaptive Fractionation Therapy – II Biological Effective Dose

Purpose:
To devise an adaptive fractionation scheme that takes into account the daily position variations between organ at risk (OAR) and the tumor and to show its improvement over conventional fractionation on the therapeutic ratio defined by biological effective dose (BED).

Method and Materials:
The relative position between OAR and the tumor determines their (physical) dose ratio according to the planned dose distribution. We assume the relative position has a known probability distribution. To determine the current fraction size, we formulate an optimization problem to minimize the expected BED of OAR subject to a given BED of the tumor and the maximal and the minimal fraction size constraints. Both the problem statement and solutions can be built inductively starting from the single fraction case. The solution which can be regarded as a fraction size lookup table describes the fraction size as a function of the dose ratio, the remaining number of fractions and the remaining BED of the tumor to be delivered. The fraction size lookup table can be pre-calculated and is used to determine the fraction size immediately after the patient's setup imaging that reveals the relative position between OAR and the tumor.

Results:
Simulations using normal distributions to generate dose ratios show that adaptive fractionation is always better than conventional fractionation. The more dose ratios vary, the more sparing of OAR it can achieve by adaptive fractionation.

Conclusions:
In general, dose ratio distributions may be obtained using population data. For a typical 20% dose ratio variation and a typical fraction size bound of 0-4 Gy, the gain of OAR sparing by adaptive fractionation is around 20% compared with conventional fractionation. As the fraction size tables are pre-calculated, online adaptive fractionation can be an effortless but effective approach.