

Modelling the induction of secondary cancers from radiotherapy

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Radiotherapy is one of the major treatment modalities for cancers, about half of the patients receiving radiation alone or in combination with other therapeutic modalities. At the same time, radiation is a carcinogenic agent and therefore the issue of the induction of secondary cancers in long term survivors from radiotherapy becomes increasingly important. In this respect there has been suggested that risk predictions could be used as complementary criteria for the selection of plans in addition to the estimation of the possible deterministic effects. Most of the data on radiation carcinogenesis risk come from radiation protection studies and therefore attempts to include risk estimations into treatment planning must take into consideration the specific features of radiation treatment, such as dose levels, dose heterogeneity and fractionation. Of particular importance is the model that describes the dose response of individual patients as well as populations of patients as may be encountered in clinical studies. This presentation explores several methods for estimating the risk of cancer following radiotherapy and investigates the influences of the particular features of radiotherapy. It also deals with the confounding factors that may be reflected in the results and may therefore hamper the interpretation of epidemiological data. In particular, it reviews the importance of dose heterogeneity and the competition between cell killing and the induction of carcinogenic mutations in predicting risk for secondary cancer, and therefore the importance of dose volume histograms for risk assessments in radiotherapy. The roles of cell survival, inducible repair and heterogeneity of the patient response were also taken into consideration for explaining the dose response curves observed experimentally. The findings stress the importance of taking into account the details of the clinical delivery of dose in radiotherapy for treatment plan evaluation or for retrospective analyses of the induction of secondary cancers as this would provide more reliable parameters for future risk modelling.