Purpose: To consolidate duodenal toxicity data from clinical studies with different dose fractionation schemes using the modified linear quadratic (MLQ) model. A methodology of adjusting the dose-volume parameters to different levels of normal tissue complication probability (NTCP) was proposed and used to estimate dose-volume constrains for treatment planning.

Methods: A set of modified Lyman model parameters for duodenum NTCP were estimated by the chi-squared fitting method using tolerance dose and equivalent uniform dose (EUD) data obtained in a literature search. These model parameters were then used to convert the dose-volume pair, \((D, V)\) to the iso-effective dose (in 2 Gy per fraction)-volume pair, \((D_{MLQED2}, V)\). A relationship was derived to convert a given \(D_{MLQED2}\) at one level of NTCP, to an iso-effective dose at another NTCP.

Results: The literature search yielded six reports useful in making estimates of small bowel/duodenal toxicity. The modified Lyman model parameters were found to be \(TD_{50} = 60.9 \pm 7.9\) Gy, \(m = 0.21 \pm 0.05\), and \(I = 0.09 \pm 0.03\) Gy^{-1}. The toxicity rates associated with hypofractionated radiotherapy (HBRT) were found to be consistent with other clinical data of conventional fractionations found in the literature. The conversion of \(D_{MLQED2}\) between different NTCP levels remains consistent with each other over a narrow range of NTCP.

Conclusion: MLQ based iso-effective calculations of dose-response data corresponding to Grade > 2 toxicity were found to be consistent with one another within the uncertainty of \(D_{MLQED2}\) due to model parameter uncertainty. The dose-volume data that can be converted to different NTCP levels may be used to estimate duodenal/small bowel dose-volume constrains for new dose fractionation and/or dose escalation strategies.

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