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, \((\text{DMLQED}2, V)\). A relationship was derived to convert a given DMLQED2 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 \(TD50 = 60.9 \pm 7.9 \text{ Gy}, m = 0.21 \pm 0.05, \) and \(Î´ = 0.09 \pm 0.03 \text{ Gy}^{-1}\). The toxicity rates associated with hypo-fractionated radiotherapy (HBRT) were found to be consistent with other clinical data of conventional fractionations found in the literature. The conversion of DMLQED2 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 DMLQED2 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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