Proposal of human spinal cord reirradiation dose based on collection of data from 40 patients.

Abstract:

PURPOSE: Driven by numerous reports on recovery of occult radiation injury, reirradiation of the spinal cord today is considered a realistic option. In rodents, long-term recovery was observed to start at approximately 8 weeks. However, prospective clinical studies are lacking. Therefore, a combined analysis of all published clinical data might provide a valuable basis for future trials. METHODS AND MATERIALS: We collected data from 40 individual patients published in eight different reports after a comprehensive MEDLINE search. These represent all patients with data available for dose per fraction and total dose of each of both treatment courses. We recalculated the biologically effective dose (BED) according to the linear-quadratic model using an alpha/beta value of 2 Gy for the cervical and thoracic cord and 4 Gy for the lumbar cord. In this model, a dose of 50 Gy given in single daily fractions of 2 Gy is equivalent to a BED of 100 Gy(2) or 75 Gy(4). For treatment with two daily fractions, a correction term was introduced to take incomplete repair of sublethal damage into account. RESULTS: The cumulative doses ranged from 108 to 205 Gy(2) (median dose, 135 Gy(2)). The median interval between both series was 20 months. Three patients were treated to the lumbar segments only. The median follow-up was 17 months for patients without myelopathy. Eleven patients developed myelopathy after 4-25 months (median, 11 months).
Myelopathy was seen only in patients who had received one course to a dose of \( \geq 102 \text{ Gy(2)} \) \((n = 9)\) or were retreated after 2 months \((n = 2)\). In the absence of these two risk factors, no myelopathy developed in 19 patients treated with \(<\) \(135.5 \text{ Gy(2)}\) or 7 patients treated with 136-150 \text{ Gy(2)}. A risk score based on the cumulative BED, the greatest BED for all treatment series in a particular individual, and interval was developed. Low-risk patients remained free of myelopathy and 33% of intermediate-risk patients and 90% of high-risk patients developed myelopathy. CONCLUSION: On the basis of these literature data (and with due caution), the risk of myelopathy appears small after \(\leq 135.5 \text{ Gy(2)}\) when the interval is not shorter than 6 months and the dose of each course is \(<\) \(98 \text{ Gy(2)}\). We would recommend limiting the dose to this level, whenever technically feasible. However, it appears prudent to propose the collection of prospective data from a greater number of patients receiving doses in the range of 136-150 \text{ Gy(2)} to assess the safety of higher retreatment doses for those patients in whom limited doses might compromise tumor control.