**Evaluation system for electronic retrospective analyses: optimization of treatment algorithms for locally advanced pancreatic cancer**


In radiation oncology recurrence analysis is an important part in the evaluation process and clinical quality assurance of treatment concepts. With the example of patients with locally advanced pancreatic cancer we developed and validated interactive analysis tools to support the evaluation workflow. Furthermore, we analyzed weekly CTs performed with an in-room CT-scanner during intensity-modulated radiotherapy (IMRT) to assess changes in the gross tumor volume (GTV) as well as adaptive radiotherapeutic (ART) approaches.

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**Purpose**

We designed and established an analysis workflow. After automatic registration of the radiation planning CTs with the follow-up images, the recurrence volumes of 9 patients were segmented manually. Based on these volumes the DVH (dose volume histogram) statistic was calculated, followed by the determination of the dose applied to the region of recurrence and the distance between the boost and recurrence volume.

For 10 patients treated with IMRT (54 Gy in 25 fractions) we provided a new approach to design an analysis system to detect recurrences according to the new guidelines. In particular, we integrated boost and weekly post irradiation CT scans. For each patient, the DVH was calculated, and the dose applied to the region of recurrence and the distance between the boost and recurrence volume was determined.
We determined dose to OAR with focus on the kidneys without ART-compensation and re-planned based on the weekly acquired CT scans to evaluate dose to OAR.

Results

For the recurrent patients, 3-7 registrations were calculated in one step. Compared to a manual approach enormous time saving can be expected. We calculated the percentage of the recurrence volume within the 80 %-isodose volume and compared it to the location of the recurrence within the boost volume, boost + 1 cm, boost + 1.5 cm and boost + 2 cm volumes. Recurrence analysis demonstrated that all recurrences except one occurred within the defined GTV/boost volume; one recurrence developed beyond the field border/outfield. With the defined distance volumes in relation to the recurrences, we could show that most recurrent lesions were within the 2 cm radius of the primary tumor. Two large recurrences extended beyond the 2 cm, however, this might be due to very rapid growth and/or late detection of the tumor progression.

Over time, changes in GTV volume were only minor and non-significant in all cases. Initial GTV volume ranged from 47.7 to 151.8 ml and volume changes during treatment from 74 to 109 %, GTV volume changes have little impact on dose application. Whereas, organ and tumor deformation were observed. After manual matching, good concordance of bony structures; soft-tissue organs, however, showed significant motion over time. With adequate margins, normal tissue constraints to OAR can be kept, but dose to OAR can be most effectively used with ART for compensation of daily movement.

All results are stored in the database of the documentation system and are reusable as new input for further calculations. Export of all data can be easily done as a CVS file (Comma-Separated Values) at any time. To allow this, a GUI-based (Graphical User Interface) SQL query builder has been implemented. These queries can be saved and reused for a continuous overview on the data.

Conclusion

The main goal of using automatic analysis tools in an evaluation system is to reduce time and effort conducting clinical analyses, especially with large patient groups. We showed a first approach and use of a semi-automated workflow for recurrence analysis, which will be continuously optimized, and how analysis tools can be used for volume comparison. Further steps need to be taken to enhance automation and connect the analysis tools to our documentation system.

In conclusion, despite the limitations of the automatic calculations we contributed to in-house optimization of subsequent study concepts. However, already it has become apparent that the benefits of digital data management and analysis lie in the central storage of data and reusability of the results. Therefore, we intend to adapt the evaluation system to other types of tumors in radiation oncology.