Editors Picks

Image registration, contour propagation and dose accumulation of external beam and brachytherapy in gynaecological radiotherapy.

Swamidas J, Kirisits C, De Brabandere M, Hellebust TP, Siebert FA, Tanderup K
Radiother Oncol. 2019 Sep 26. pii: S0167-8140(19)33069-5. doi: 10.1016/j.radonc.2019.08.023. [Epub ahead of print]

What was your motivation for initiating this study?

- Deformable Image Registration (DIR) is a constantly evolving area of research. There are quite a few DIR algorithms available, both commercial and freeware; however, currently, there is not much knowledge among the radiotherapy community as to which DIR algorithm should be used for which application. Hence, the study was an attempt to summarise the solutions available specifically for gynaecological brachytherapy (BT) and to consider their pitfalls to improve awareness and foster discussion.
- We would specifically like to add a cautionary note for clinical users, as the current generation of DIR algorithms is limited in complexity. Hence direct application of DIR algorithms for dose accumulation of External Beam Radiotherapy (EBRT) and BT may not be warranted.

What were the main challenges during the work?

- The reporting of results in the algorithms was not uniform; for example, the doses were quoted in physical units by some and in EQD2 by others. Similarly, regarding quality indices, some quoted Target Registration Error (TRE), and others, Dice Similarity Coefficient (DSC) and Hausdroff distance. These differences made the comparisons challenging.
- Insufficient information regarding methods of registration and dose accumulation also added to the complexity while comparing the results.
- Since the field is evolving, a new article is published every two weeks, so keeping updated with every new article during the manuscript writing was interesting but challenging as well.

What are the most important findings of your study?

- Deformable dose accumulation of EBRT using intensity modulated radiotherapy/volumetric modulated arc therapy (IMRT/VMAT) and BT is associated with a wide range of variation and uncertainties, due to implausible registration.

- The current generation of DIR algorithms is not yet robust enough to handle complexities that involve dose accumulation of EBRT and BT in gynaecological cancers.

What are the implications of this research?

- Deformable dose accumulation of EBRT and BT results in implausible registration due to various factors such as dose gradient, dose fraction size, tumour shrinkage, anatomical changes such as bladder-rectum filling, presence of applicator, and vaginal pack, among other things.

- Given these findings, our work also represents a call to researchers to invest their efforts in the development of more intelligent solutions to handle these complexities.

Jamema Swamidas
Department of Radiation Oncology
Advanced Centre for Treatment Research & Education in Cancer
Tata Memorial Centre
Mumbai, India