Radiomics: transforming standard imaging into mineable data related to biology

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The rise of radiomics, the high-throughput mining of quantitative image features from (standard-of-care) medical imaging for knowledge extraction and application within clinical decision support systems (animation: [https://youtu.be/Tq980GEVP0Y](https://youtu.be/Tq980GEVP0Y)) to improve diagnostic, prognostic, and predictive accuracy, has significant and substantial implications for the medical community (1, 2, 5). Radiomic analysis exploits sophisticated image analysis tools and the exponential growth of medical imaging data to develop and validate powerful image-based signatures/models. We will describe the process of radiomics, its pitfalls, challenges, opportunities, and its capacity to improve clinical decision making (presently primarily in the care of patients with cancer, however, all imaged patients may benefit from quantitative radiology) (5,8). Finally, the field of radiomics is emerging rapidly; however, the field lacks standardized evaluation of both the scientific integrity and the clinical significance of the numerous published radiomics investigations resulting from this growth. There is a clear and present need for rigorous evaluation criteria and reporting guidelines in order for radiomics to mature as a discipline (see www.radiomics.world). Certain author’s proposed that radiomics could be used as a “virtual biopsy”. It could be the case in the sense that several reports demonstrated that biological features of tumours such as EGFR mutations, HPV status and even hypoxia could be quantified by radiomics (6). There are however two main differences: a) Radiomics is based on the whole tumour in contrast to a biopsy taken most often randomly in an heterogeneous tumour and b) the radiomics values is a continuous variable in contrast to molecular biology assays which are often dichotomized (e.g. mt vs wt). Interestingly, certain radiomics signatures e.g. a proliferation radiomics signature, works as well with cone beam CT which opens the field of “4D-Radiomics” (4, 7). There is a need of preclinical Radiomics studies to establish causal relationship between biology and image signatures (3).

References:

Multifactorial Decision Support Systems: a “must” for Precision medicine?

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A paradigm shift from current population based medicine to personalized and participative medicine is underway. This transition is being supported by the development of clinical decision support systems (DSS) based on prediction models of treatment outcome (3, 6). In radiation oncology, these models ‘learn’ using advanced and innovative information technologies (ideally in a distributed fashion - please watch the animation: http://youtu.be/ZDJFOxpwqEA ) from all available/appropriate medical data (clinical, treatment, imaging, biological/genetic, etc.) to achieve the highest possible accuracy with respect to prediction of tumor response and normal tissue toxicity (5). In this presentation, we will deliver an overview of the factors that are associated with outcome in radiation oncology and discuss the methodology behind the development of accurate prediction models, which is a multi-faceted process (4,7). Subsequent to initial development/validation and clinical introduction, decision support systems should be constantly re-evaluated (through quality assurance procedures) in different patient datasets in order to refine and re-optimize the models, ensuring the continuous utility of the models. We will present two concrete examples of DSS one for choice of protontherapy, another for the decision to implant a spacer (watch the animation: https://youtu.be/tDlagSXMKow ) (2, 1). In the not so distant future, decision support systems will be fully integrated within the clinic. , Data and knowledge will be shared in a standardized, dynamic, and potentially global manner enabling truly personalized and participative medicine (3). The real merge of personalized and participative medicine will translate in “individualized Patient Decision Aids” (3).

References: