EBioMedicine 62 (2020) 103136

Contents lists available at ScienceDirect

EBioMedicine

journal homepage: www.elsevier.com/locate/ebiom

Commentary

Pictures worth more than a thousand words: Prediction of survival in medulloblastoma patients

Asier Rabasco Meneghetti[a,b,*], Alex Zwanenburg[a,c,d], Steffen Löck[a,c,e]

[a] OncoRay - National Center for Radiation Research in Oncology, Faculty of Medicine and University Hospital Carl Gustav Carus, Technische Universität Dresden, Helmholtz-Zentrum Dresden - Rossendorf, Dresden, Germany
[b] Institute of Radiooncology – OncoRay, Helmholtz-Zentrum Dresden - Rossendorf, Dresden, Germany
[c] German Cancer Consortium (DKTK), partner site, Dresden, Germany and German Cancer Research Center (DKFZ), Heidelberg, Germany
[d] National Center for Tumor Diseases (NCT), Partner Site Dresden, Germany: German Cancer Research Center (DKFZ), Heidelberg, Germany; Faculty of Medicine and University Hospital Carl Gustav Carus, Technische Universität Dresden, Dresden, Germany, and; Helmholtz Association / Helmholtz-Zentrum Dresden – Rossendorf (HZDR), Dresden, Germany
[e] Department of Radiotherapy and Radiation Oncology, Faculty of Medicine and University Hospital Carl Gustav Carus, Technische Universität Dresden, Germany

ARTICLE INFO

Article History:
Received 6 November 2020
Accepted 6 November 2020

An old saying goes "a picture is worth more than a thousand words". This adage traditionally means that complex ideas can be conveyed by just one image. The saying might be surprisingly accurate even today, as data are extracted from all sorts of images, from pictures on social media to routinely obtained clinical images. Within this issue of *EBioMedicine*, Yan et al. [1] employ radiomics techniques to extract quantifiable information, or features, from magnetic resonance imaging (MRI) of patients with medulloblastoma and compare their value with common clinicomolecular factors such as age, gender, molecular subgroup, or resection status for prognosis of overall survival and progression-free survival.

Medulloblastoma is one of the most common forms of brain cancer in children from 0 to 14 years of age [2]. These tumours are invasive, grow rapidly, and have symptoms that evolve over the course of several weeks to months. Such symptoms include behavioural changes, anorexia, lethargy, and coordination difficulties among others. Currently, medulloblastoma are treated primarily using surgery, radiotherapy and adjuvant chemotherapy. However, only 1 in 2 patients survive past the 5-year mark [3]. So far, most radiomics studies in medulloblastoma aimed at finding features predictive of the four different molecular subtypes of medulloblastoma [4] or on differential diagnosis of medulloblastoma and other brain tumour types [5]. Alongside the manuscript of Li et al. [6], the present manuscript is one of the first to assess radiomics for prognosticating patient survival, in particular including tumours of all four subtypes.

Tumour heterogeneity is thought to be a factor hindering successful treatment of patients [7]. In the present manuscript, the authors identified eleven radiomic features of which the majority were texture features. Such features may reflect heterogeneity at a macroscopic level. Furthermore, these features were shown to be significantly related to genes participating in enriched *p53*, *PI3K/AKT*, interleukin-2 pathways, WNT signaling and membrane protein activities. The enriched pathways in turn relate to the different molecular subtypes of medulloblastoma. With this analysis, the authors address a common obstacle in applying results of radiomics studies, which is the missing mechanistic understanding of the identified imaging features, i.e. their relation to the underlying biological processes in tumour response to treatment [8]. Understanding this relation is imperative for the translation of radiomics biomarkers into clinical application. While several studies performed similar initial analyses for different tumour entities [9], larger datasets with paired imaging and genetic data are required for further progress.

In the present manuscript, the 11-feature radiomics signature was combined with other clinicomolecular factors that are commonly used for survival prognosis in medulloblastoma. Model performance was found to be higher when considering both data sources together compared to a model based on clinicomolecular parameters only. This complementarity between radiomics and clinicomolecular factors has also been observed in other tumour entities. In general, the integration of different data sources, as demonstrated in the present manuscript, is a step forward towards the general aim of personalised cancer treatment [10]. Here, the development of accurate prognostic models is required in order to assign patients to the best treatment option. In this context, the collection, understanding and integration of different multi-omics datasets that describe the tumour at different levels is imperative.

Still, the present study is not without limitations. Additional samples with both RNA-sequencing and MRI would be required to further solidify the findings for the pathway enrichment and substantiate the underlying relationship to the radiomics features. Furthermore, the signature might be specific mainly for one of the different molecular subtypes of medulloblastoma, as almost half the patients suffered from medulloblastoma of molecular subgroup Group 3. The model

* Corresponding author.
E-mail address: asier.rabasco@oncoray.de (A. Rabasco Meneghetti).

https://doi.org/10.1016/j.ebiom.2020.103136

might therefore perform differently in a more balanced cohort. Also, while the prognosis for overall survival clearly improved with the addition of radiomics features, the improvement of progression-free survival was limited. Like any study that presents a signature for prognosis of an outcome related to patient survival, the results should be prospectively and externally validated in the hope that the signature can one day be confidently translated to clinical application. Presently, this is an aim that the field of radiomics as a whole has to advance towards [8]. Since the authors followed the Image Biomarker Standardisation Initiative (IBSI) guidelines, we hope that future studies may reproduce and validate their developed signature.

In conclusion, the results of Yan et al [1] show that radiomics can not only be useful for survival prognosis in medulloblastoma alongside traditional clinicomolecular factors, but also that such features may be related to underlying biological processes.

Contributors

Mr. Rabasco contributed the structure and writing of the manuscript. Dr. Zwanenburg and Dr. Löck contributed updates and continued corrections to the manuscript.

Declaration of Interests

Mr. Rabasco and Doctor Löck do not have any conflict of interest. Dr Zwanenburg founded the Image Biomarker Standardisation initiative that seeks to improve reproducibility of radiomics studies.

References

[1] Yan J, Zhang S, Li KK-W, Wang W, Li K, Duan W, et al. Incremental prognostic value and underlying biological pathways of radiomics patterns in medulloblastoma. E Bio Med 2020;61:103093. https://doi.org/10.1016/j.ebiom.2020.103093.
[2] Millard NE, De Braganca KC. Medulloblastoma. J Child Neurol 2016;31:1341–53. https://doi.org/10.1177/0883073815600866.
[3] Leece R, Xu J, Ostrom QT, Chen Y, Kruchko C, Barnholtz-Sloan JS. Global incidence of malignant brain and other central nervous system tumors by histology, 2003-2007. Neuro Oncol 2017;19:1553–64. https://doi.org/10.1093/neuonc/nox091.
[4] Fan Y, Feng M, Wang R. Application of radiomics in central nervous system diseases: a Systematic literature review. Clin Neurol Neurosurg 2019;187:105565. https://doi.org/10.1016/j.clineuro.2019.105565.
[5] Gutierrez DR, Awwad A, Meijer L, Manita M, Jaspan T, Dineen RA, et al. Metrics and textural features of MRI diffusion to improve classification of pediatric posterior fossa tumors. Am J Neuroradiol 2014;39:1009–15. https://doi.org/10.3174/ajnr.A3784.
[6] Li J, Chen C, Fu R, Zhang Y, Fan Y, Xu J, et al. Texture analysis of T1-weighted contrast-enhanced magnetic resonance imaging potentially predicts outcomes of patients with non−wingless-type/Non−Sonic Hedgehog Medulloblastoma. World Neurosurg 2020;137:e27–33. https://doi.org/10.1016/j.wneu.2019.09.142.
[7] Jamal-Hanjani M, Quezada SA, Larkin J, Swanton C. Translational implications of tumor heterogeneity. Clin Cancer Res 2015;21:1258–66 https://doi.org/10.1158/1078-0432.CCR-14-1429.
[8] Park JE, Kim D, Kim HS, Park SY, Kim JY, Cho SJ, et al. Quality of science and reporting of radiomics in oncologic studies: room for improvement according to radiomics quality score and TRIPOD statement. Eur Radiol 2020;30:523–36. https://doi.org/10.1007/s00330-019-06360-z.
[9] Bodalal Z, Trebeschi S, Nguyen-Kim TDL, Schats W, Beets-Tan R. Radiogenomics: bridging imaging and genomics. Abdom Radiol 2019;44:1960–84. https://doi.org/10.1007/s00261-019-02028-w.
[10] Baumann M, Krause M, Overgaard J, Debus J, Bentzen SM, Daartz J, et al. Radiation oncology in the era of precision medicine. Nat Rev Cancer 2016;16:234–49. https://doi.org/10.1038/nrc.2016.18.