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Media release

October 14, 2021, Embargo October 14, 2021, 16:00h CET

Radiomics

Pulmonary fibrosis: reliable prognosis thanks to AI

Today, October 14, 2021, a research team from the Universities of Zurich, Oslo and Bern and their respective University Hospitals has published results on AI-supported image analysis of pulmonary fibrosis, which occurs in rare systemic sclerosis. By applying methods of radiomics analysis, the researchers, led by principal investigator Prof. Britta Maurer, have produced surprisingly clear risk profiles that offer a promising basis for future personalized patient management.

Radiomics refers to the specific application of artificial intelligence (AI) for interpreting image data: for example, computed tomography (CT) scans. Its use thus far has been limited to oncology. The present study now applies radiomics to the previously unexplored field of interstitial lung disease (ILD). Systemic sclerosis is a rare autoimmune disease involving multiple organs, and pulmonary involvement is the leading cause of death in patients with systemic sclerosis. Untreated, mortality is comparable to that of cancer. This study attempts to use radiomics to identify patient profiles with well-defined prognoses to improve clinical risk assessment and patient management.

Radiomics identifies two distinct patient groups

Analysis of routine, annual follow-up CT scans by means of radiomics was able to identify two clearly distinguishable groups of patients. The two groups had different clinical characteristics and different, well-defined risk profiles for the probability of survival with and without progression of ILD. For clinical application, the next step was to develop a risk score (risk assessment) that could subdivide patients according to the risk of progression of lung disease (high vs. low risk). This score, confirmed in a control group, revealed a much more reliable detection of patients at risk compared to previously applied clinical or functional parameters. Dr. rer. nat. Janine Schniering, first author of the study, classifies the result as follows: *"If these data can be confirmed in a prospective trial, this AI approach will provide the clinician with a scientifically based, functioning tool for risk assessment and thus for personalized consultation and treatment planning in the future."*

AI image analysis finds correlation at the tissue level

The project went one significant step further in a second part. The researchers attempted to find molecular biological equivalents for the radiomics-identified risk groups in an animal model. For this purpose, mice were examined following chemically induced pulmonary fibrosis. Promising

correlations were found between the risk profiles obtained from CT images and the processes concerning the development of connective tissue proliferation (fibrosis) of lung tissue in the animal model. A high risk for progressive lung disease obtained by AI image analysis coincided with the activation of processes that led to progression of fibrosis in the tissue.

Researchers take innovative approach

In several respects, the present project breaks new methodological ground. For example, it is the first time that image data from patients with pulmonary fibrosis due to system sclerosis has been processed using the methods of radiomics analysis. Furthermore, it combines multi-species data from computed tomographic imaging with molecular biological results from tissue analyses. Prof. Dr. med. **Britta Maurer**, head of the study, emphasizes another patient benefit of her research: *"The fact that CT image analysis can specifically correlate processes of fibrosis at the tissue level represents a breakthrough. This gives rise to the hope that one day it will be possible to draw conclusions about specific physiological and pathophysiological processes based entirely on non-invasive images. This would eliminate the need for tissue sampling with invasive procedures."*

Prospects

This work demonstrates the great potential of radiomics in the analysis and prognosis of pulmonary fibrosis in systemic sclerosis. The research team is therefore highly interested in investigating, in close collaboration with Inselspital, other types of fibrotic ILD. Radiomics, among other things, could be used to predict the potential success of anti-fibrotic therapies. To this end, various national and international collaborations are underway or in the planning.

Experts:

- Dr. sc. ETH Janine Schniering, Postdoctoral Fellow, Institute of Lung Biology and Disease (ILBD), Comprehensive Pneumology Center, Helmholtz Zentrum München
- Prof. Dr. med. Britta Maurer, Ordinaria in Rheumatology, Chairwoman and Head University Department of Rheumatology and Immunology, Inselspital, University Hospital Bern and University Bern

Links:

- Original publication: *Schniering J, Maciukiewicz M, Gabrys HS, et al.* Computed tomography-based radiomics decodes prognostic and molecular differences in interstitial lung disease related to systemic sclerosis. Eur Respir J 2021; in press https://doi.org/10.1183/13993003.04503-2020
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