Conclusions: This pilot study indicates that, even in the absence of cartilage erosions, significant differences are seen in cartilage integrity with higher $T1\rho$ relaxation times in patients with knee arthritis. This might indicate loss of glycosaminoglycan content in active synovitis of the knee. Thus, our pilot data suggest that $T1\rho$ could serve as an imaging biomarker for cartilage integrity, ultimately aiming to prevent irreversible cartilage damage and long-term disability in this young JIA population.

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SAT0645

DIAGNOSTIC ACCURACY OF SERUM AUTOANTIBODIES MULTI-TESTING IN RHEUMATOID ARTHRITIS AND ECONOMIC CONSEQUENCES ACROSS EUROPE

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Background: Rheumatoid arthritis (RA) diagnosis requires interpretation of a combination of clinical, laboratory and imaging investigations. In RA, the consequences of incorrect serology test results are particularly important: patients with False Positive results (FPs) are initially managed as RA patients, bringing about extra costs until a correct diagnosis is made.

Objectives: The first aim of the study was to evaluate the diagnostic performance of RF-IgA, RF-IgM, and CCP, used alone or in multi-testing parallel or sequential combinations. The secondary goal focused on the economic consequences of serology FPs in selected European countries.

Methods: 190 established RA patients and 197 controls (either affected by other conditions or healthy donors) were used to assess the diagnostic performance of mono- and multi-serology testing in PC; both testing in Primary Care (PC) and in Secondary Care (SC) settings were considered.

For the secondary objective, a 12 month Markov model simulated, from the National Health Services perspective, 1.000 RA-suspected individuals tested in PC and SC with mono- or multi-testing. Costs come from the published literature. The European countries included in the analysis were the United Kingdom, Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Portugal, Spain and Sweden. Uncertainty was addressed with sensitivity analysis.

Results: The mono-testing diagnostic performance was:

- RF-IgA: sensitivity [95% CI]=40.5% [33.5%, 47.9%], specificity=92.4% [87.8%, 95.7%];
- RF-IgM: sensitivity=59.0% [51.6%, 66.0%], specificity=89.3% [84.2%, 93.3%];
- CCP: sensitivity=59.5% [52.1%, 66.5%], specificity=96.5% [92.8%, 98.6%].

In multi-testing, defining a "positive result" as "positivity to at least one test" increased sensitivity; "positivity to all the tests" increased specificity. In a PC scenario:

- parallel testing:
 - o using CCP and RF-IgM increased specificity to 99.5% [97.2%, 100.0%];
 - o the three tests used simultaneously maximised specificity (100.0% [98.1%, 100.0%]), but reduced sensitivity to 35.8% [29.0%, 43.1%];
- sequential testing: testing positive to both RF-IgA and RF-IgM followed by CCP testing led to 90.7% [81.7%, 96.2%] sensitivity and to 100.0% [54.1%, 100.0%] specificity.

With respect to mono-testing, multi-testing options reduced the number of FPs. Therefore, in each of the countries considered, multi-testing allowed for important cost savings due to reduced clinical procedures and resource utilisation of FPs.

Conclusions: Multi-serology testing improve the diagnostic accuracy of the individual RF-IgA, RF-IgM and CCP tests. Optimal multi-testing combinations minimise the number of FPs, thus reducing avoidable costs to the National Health Services. Consequently, multi-testing for RA demonstrates superior value from patient and payer perspective.

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DEVELOPMENT AND VALIDATION OF A DEEP LEARNING ALGORITHM FOR CLASSIFYING ANTI-NUCLEAR ANTIBODY PATTERNS IN INDIRECT IMMUNOFLUORESCENCE IMAGES

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Background: Antinuclear antibody (ANA) is a valuable test in the evaluate for a variety of autoimmune diseases. It can be detected using immunofluorescence (IIF) which yield both serum titers and also staining patterns. The manual titration of ANA is laborious and evaluation of staining patterns by a microscope requires experts to make correct classification. Deep learning is a collection of computational methods that enable an algorithm to 'learn' from a large set of data to acquire 'skills' that are characteristic of human intelligence, for example, complex pattern recognition. Application of these methods to ANA pattern classification requires further assessment and validation.

Objectives: To train a deep convoluted neural network to create an algorithm for automated classification of ANA patterns in images of indirect immunofluorescence.

Methods: We construct a deep convoluted neural network based on inception V3. The model adopted a deep learning architecture with 21 layers and ANA images were used to train to detect speckled, homogenous, nucleolar, centromere, dense fine speckled, cytoplasmic and mitochondrial patterns. The data were collected from rheumatology patients from June 2016 to October 2017. We validate the performance of the model using a separate set of images.

Results: Our data set consisted of 81822 ANA images from 8839 patients. The overall accuracy was 99.46% after 200 epochs of iteration using the training dataset (65 458 images) and the accuracy was 96.33% using the validation dataset (16.64 images). The sensitivity was 97.1% for speckled pattern, 91.4% for homogenous pattern, 97.1% for nucleolar pattern, 97.1% for centromere pattern, 97.2% for cytoplasmic pattern, and 100% for both dense fine speckled and mitochondrial patterns. The specificity was also good, ranged between 97.1% and 100%.

Conclusions: In this study, an algorithm based on deep convoluted neural network had high sensitivity and specific for detecting specific ANA patterns. Further research is needed to determine the feasibility to deploy the technology in routine clinical works to assist rheumatologists to interpret ANA.

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