POS0320

AI METHOD FOR PREDICTING RA STATUS

Artificial intelligence-based approach to predicting the disease course in patients with rheumatoid arthritis

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Rheumatoid Arthritis (RA) is an autoimmune disease which affects approximately 0.8 % of the Finnish population. Increasing number of conventional and biological antirheumatic drugs is currently available for the treatment of RA. However, for the optimal use of these drugs and for example for the decision when to start biological medication, it would be of utmost importance to be able to predict the disease course of the patient during the patient's visit at the clinic.

Objectives

The disease course of the patients differs widely and predicting the disease course is challenging. Therefore, our objective was to use patient-specific disease characteristics and to develop an artificial intelligence (AI) method for predicting the future disease course . Our patient material includes 1881 patients , with both sero positive and negative diseases (ICD-10-codes M05 and M06).

Methods

We used a machine learning method which takes as input patient information such as demographic information and clinical variables. The target value that the method tries to predict is the DAS28-CRP disease marker a year from the present time. The train and test sets were balanced so that each DAS28-CRP value is expressed equally. The machine learning model was a voting ensemble with Random Forest and Extreme Random Trees classifiers and with different scalers (Geurts et al. 2006). The number of training instances was 1504 and test set consisted of 377 patients. The number of features was 30. The patients were classified to 4 classes: inactive, low, high and very high according to the activity marker DAS28-CRP.

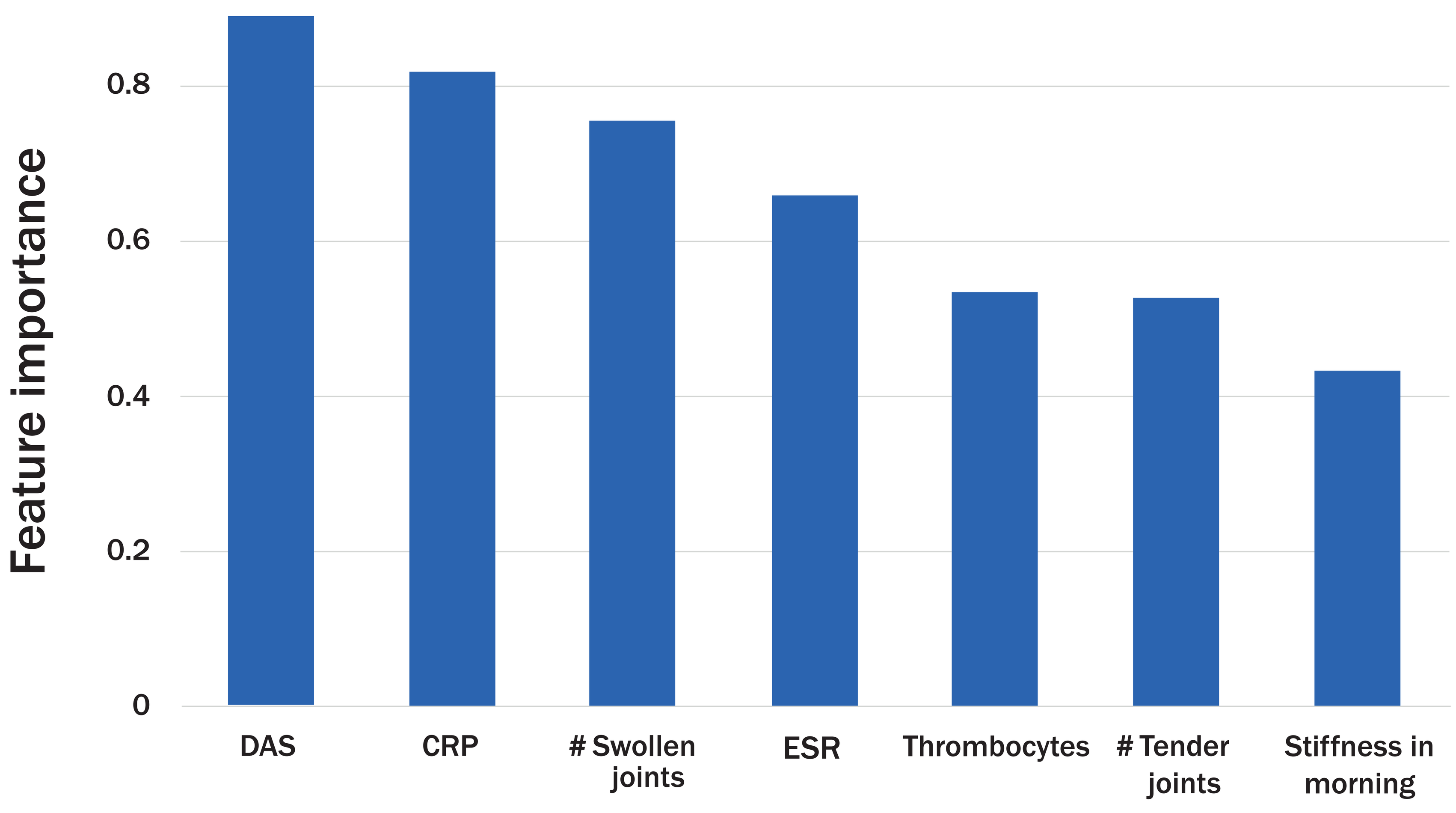

Fig.1 Overall feature importance for all classes. The higher the bar, the more useful the feature is in classifying the patients.

True Label \ Predicted Label	high	inactive	low	very_high
high	24	9	33	27
inactive	9	29	38	19
low	18	11	45	21
very_high	34	0	6	54

Table 1 A confusion matrix of classifying the test material. In the left are the true labels and on top the predicted labels. The classes low and very high have been most successfully predicted.

Results

The AUC value of the classifier was 0.71. This provides adequate extra information for the clinicians when they consider the patient's treatment. If the method shows that the patient is likely to get worse, treatment can be intensified and extra visits to the policlinic can be scheduled. If the model predicts that disease is getting better, visits can be more infrequent. Figure 1 shows the most important variables used by the classification algorithm. The AI algorithm gives good predictions (Table 1), even though errors between two adjacent activity classes are common. For example, when the true class is very high, the algorithm gives 88 high or very high predictions (94%), and only 6 clearly wrong answers (6%). When the true class is high, the results are more spread, with 42 cases (45%) being in the low or inactive class and 51 (55%) cases in the more active class. The low and inactive classes are predicted quite well.

Conclusion:

The algorithm shows promising results especially in predicting very high disease activity. An algorithm with AUC 0.71 cannot reliably classify patients independently, but it can aid the clinician in giving insights into the patients' current status and how likely the worsening of the disease is. The AI method chosen for this purpose is a white-box approach, meaning that the clinician can immediately see which factors were deemed important by the algorithm to produce this prediction.

References

Geurts, P., Ernst, D. & Wehenkel, L. Extremely randomized trees. Mach Learn 63, 3–42 (2006).

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