Abstract

Objectives. Several sets of criteria for the diagnosis of axial SpA (including non-radiographic axial spondyloarthritis) have been proposed in the literature in which scores were attributed to relevant findings and the diagnosis requests a minimal sum of these scores. To quantitatively estimate the probability of axial SpA, multiplying the likelihood ratios of all relevant findings was proposed by Rudwaleit et al. in 2004. The objective of our proposal is to combine the advantages of both, i.e. to estimate the probability by summing up scores instead of multiplying likelihood ratios.

Methods. An easy way to estimate the probability of axial spondyloarthritis is to use the logarithms of the likelihood ratios as scores attributed to relevant findings and to use the sum of these scores for the probability estimation.

Results. A list of whole-numbered scores for relevant findings is presented, and also threshold sum values necessary for a definite and for a probable diagnosis of axial SpA as well as a threshold below which the diagnosis of axial spondyloarthritis can be excluded. In a diagram, the probability of axial spondyloarthritis is given for sum values between these thresholds.

Conclusion. By the method proposed, the advantages of both, the easy summing up of scores and the quantitative calculation of the diagnosis probability, are combined. Our method also makes it easier to estimate which additional tests are necessary to come to a definite diagnosis.

Key words: axial spondyloarthritis, diagnosis, probability estimation.
Methods

Our proposal makes use of the fact that multiplying a number of factors is equivalent to adding their logarithms (the reason why logarithm tables were widely in use in engineering before the advent of mechanical and electronic calculators). Accordingly, Eq. (1) can also be written in the form

\[
P_{\text{post}} = \frac{\sum \ln(LR) \times P_{\text{pre}}}{1 + \sum \ln(LR) - 1} \times P_{\text{pre}}
\]

with \(\sum \ln LR\) being the sum of the natural logarithms of the LR values.

In order to get whole-numbered scores without losing too much accuracy, we call 10-inLR the score of a finding. We make use of the LRs derived by Rudwaleit et al. [9, 10] from sensitivity and specificity values found in the literature for diagnosing axial SpA. Relevant SpA features include clinical features (inflammatory back pain, enthesitis, arthritis, dactylitis, acute anterior uveitis, psoriasis, IBD, positive family history and good response to NSAIDs), associated laboratory findings (acute phase reactants, HLA-B27) and sacroiliitis shown by MRI.

Results

The scores of relevant findings derived from the LR values given in Rudwaleit et al. [9, 10] are listed in Table 1. Since the validity of incorporating negative LRs has never been validated, we recommend to ignore negative test results in an early state of possible axial SpA and therefore have included in Table 1 only positive LRs. This is also reasonable because some of the SpA features may not be present at disease onset but may develop later, and their absence in early disease does not mean anything. How the post-test probability of axial SpA depends on the sum of the scores if the pre-test probability is 5% (chronic back pain, i.e. back pain of >3 months duration with age at onset <45 years) is shown in Fig. 1.

As in Rudwaleit et al. [9, 10], we regard a diagnosis of axial SpA as definitive if the probability is at least 90%. This is the case if the sum of the scores is >51. Correspondingly, a diagnosis of probable axial SpA can be made if the sum of the scores is larger than 43 (probability >80%). If the sum of scores is <13 (probability <15%), axial SpA is improbable. For score sums between 13 and 43, additional tests are necessary to come to a decision.

Discussion

Deriving the probability of axial SpA from the score sum by means of Fig. 1 is identical with deriving the probability of axial SpA from the product of LR values as proposed by Rudwaleit et al. [10].

For sacroiliitis on MRI, a positive LR of 9.0 was established in 2004 [9, 10] which was the best estimate at that time. According to recent studies [14, 15], the positive LR may be essentially higher, up to 44.6 with MRI readers specially trained for this purpose. A positive LR of 44.6

![Table 1: Relevance of several findings for the diagnosis of axial spondyloarthritis](https://academic.oup.com/rheumatology/article-abstract/52/9/1648/1792997)

<table>
<thead>
<tr>
<th>Finding</th>
<th>LR+ according to [9, 10]</th>
<th>Score if test result is positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflammatory type of back pain [12, 13]</td>
<td>3.1</td>
<td>11</td>
</tr>
<tr>
<td>Heel pain (enthesitis)</td>
<td>3.4</td>
<td>12</td>
</tr>
<tr>
<td>Peripheral arthritis</td>
<td>4.0</td>
<td>14</td>
</tr>
<tr>
<td>Dactylitis</td>
<td>4.5</td>
<td>15</td>
</tr>
<tr>
<td>Iritis or anterior uveitis</td>
<td>7.3</td>
<td>20</td>
</tr>
<tr>
<td>Psoriasis</td>
<td>2.5</td>
<td>9</td>
</tr>
<tr>
<td>IBD (Crohn’s disease or ulcerative colitis)</td>
<td>4.0</td>
<td>14</td>
</tr>
<tr>
<td>Positive family history of axial SpA, reactive arthritis, psoriasis, IBD or anterior uveitis</td>
<td>6.4</td>
<td>19</td>
</tr>
<tr>
<td>Good response to NSAIDs</td>
<td>5.1</td>
<td>16</td>
</tr>
<tr>
<td>Raised acute-phase reactants (CRP/ESR)</td>
<td>2.5</td>
<td>9</td>
</tr>
<tr>
<td>HLA-B27</td>
<td>9.0</td>
<td>22</td>
</tr>
<tr>
<td>Sacroiliitis shown by MRI</td>
<td>9.0</td>
<td>22</td>
</tr>
</tbody>
</table>

In order to get whole-numbered scores without losing too much accuracy, we call 10-inLR the score of a finding. We make use of the LRs derived by Rudwaleit et al. [9, 10] from sensitivity and specificity values found in the literature for diagnosing axial SpA. Relevant SpA features include clinical features (inflammatory back pain, enthesitis, arthritis, dactylitis, acute anterior uveitis, psoriasis, IBD, positive family history and good response to NSAIDs), associated laboratory findings (acute phase reactants, HLA-B27) and sacroiliitis shown by MRI.

![Fig. 1: Dependence of the probability of axial SpA on the sum of scores according to Table 1 for a pre-test probability of 5% (chronic back pain, i.e. back pain of >3 months duration with age at onset <45 years)](https://academic.oup.com/rheumatology/article-abstract/52/9/1648/1792997)

A diagnosis of definitive axial SpA can be made if the score sum is >51 (probability >90% as proposed in Rudwaleit et al. [9, 10]). A diagnosis of probable axial SpA can be made if the score sum is >43 (probability >80%). If the score sum is <13, axial SpA is improbable (probability <15%). For score sums between 13 and 43, additional tests are necessary to come to a decision.
would correspond to a score of 38. However, in the very same publication [14], a LR+ of 9.8 derived if a global assessment of sacroiliitis on MRI was considered according to agreement of any two of five readers, a figure that is not very different from the LR of 9.0 proposed in 2004 [10]. Thus, until definite data become available, we stick to the conservative positive LR of 9.0 for sacroiliitis on MRI.

Conclusion

Here we make a proposal on how to simplify the probability calculations of the presence of early axial SpA, in particular non-radiographic axial SpA. Whereas the Assessment of Spondyloarthritis International Society (ASAS) criteria for axial SpA are meant for the classification of groups of patients for studies, the disease probability calculations are meant for diagnosing individual patients.

Summing up the scores given in Table 1 makes it easier to estimate the probability of the diagnosis axial SpA. Summing up whole-numbered scores is more comfortable and does not require a pocket calculator. Our method also makes it easier to estimate which additional tests are necessary to come to a definite diagnosis.

Rheumatology key message

- The diagnosis probability of axial SpA can easily be estimated by summing scores.

Disclosure statement: M.R. has received honoraria for consultancies and/or scientific presentations from AbbVie, BMS, MSD, Pfizer, Roche/Chugai and UCB. All other authors have declared no conflicts of interest.

References