Interobserver Agreement of the TASC II Classification for Supra- and Infrainguinal Lesions


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Interobserver agreement; Magnetic resonance angiography; Claudication; PAOD; TASC

Abstract
Objectives: The Trans-Atlantic Inter-Society Document on Management of Peripheral Arterial Disease (TASC) gives treatment recommendations depending on the classification of aorto-iliacal or femoro-popliteal vascular pathologies. Therefore, the best treatment could only be offered if the right TASC classification was obtained. The purpose of this study was to assess the interobserver agreement of the evaluation of the TASC II classification for peripheral arterial occlusive disease (PAOD) in magnetic resonance angiography (MRA).

Patients and methods: Three hundred arterial segments of 149 patients with a magnetic MRA for PAOD were evaluated according to the TASC II classification. A resident and a consultant for radiology and vascular surgery both performed independent grading. A comparative assessment of the consensus agreement was quantified by the marginal probabilities calculated by generalised estimation equation models, as well as by using the weighted kappa coefficient (κ), classified according to Altman.

Results: In relation to the consensus, the overall agreement was good to excellent for the consultants of radiology and vascular surgery. The consultants obtained a statistically significant higher agreement than did the residents (Odds ratio (OR): 2.86, 95% confidence interval (CI): 2.21–3.69, p < 0.001). A significantly higher consensus agreement probability was observed for the consultants compared with the radiologists (OR: 1.43, 95% CI: 1.11–1.84, p = 0.006) and for the femoro-popliteal regions compared with the aorto-iliacal regions (OR: 1.64, 95% CI: 1.12–2.14, p = 0.012).
Peripheral arterial occlusive disease (PAOD) affects up to 10% of the Western population over 65 years of age and has an age-dependent prevalence of 3–6% when intermittent claudication is used as an indicator.1,2 The clinical manifestations of PAOD can start at an asymptomatic stage and result in major tissue loss; these are classified according to Rutherford or Fontaine. Similarly, the therapeutic options range broadly from conservative treatment to endovascular or open surgical procedures. To determine the best therapeutic option, knowledge about the clinical stage and morphological changes in the vascular system are necessary. Nevertheless, remarkable disagreements between and among surgeons and interventional radiologists occur regarding the best therapy (surgery or angioplasty) for severe limb ischaemia.3

Different vascular imaging techniques such as colour Doppler ultrasound, magnetic resonance angiography (MRA), computed tomography angiography and digital subtraction angiography are available for the detection of vascular pathologies. MRA is more frequently used since it is non-invasive, uses no radiation, is not dependent on the investigator and does not need iodinated contrast.4,5

For a classification of the morphological changes in the vascular system, the most widespread and applied document is the Trans-Atlantic Inter-Society Document on Management of Peripheral Arterial Disease (TASC), first published in 2000 and revised in 2007.6,7 In this document, depending on the amount and severity of the stenosis or occlusions of the arteries, vascular pathologies of the aorto-iliacal and femoro-popliteal region are divided into four grades each (TASC A–D). In the latest TASC document, recommendations 36 (aorto-iliacal) and 37 (femoro-popliteal) state that TASC A pathologies should be treated by endovascular therapy and TASC D lesions should be operated upon. Depending on the co-morbidities, TASC B lesions should also be treated by endovascular therapy and TASC C lesions by surgery.1 This shows that it is important to assess vascular pathologies correctly to find the best treatment option for patients with a need for non-conservative treatment.

The aim of this study was to assess the interobserver agreement of evaluation of the TASC II classification for PAOD in MRA; this classification is the basis of daily treatment decisions and, thus, a high reliability of grading and interobserver agreement are needed.

Patients and methods

Patients

A total of 149 consecutive patients presenting with PAOD to our centre for vascular diseases were investigated by MRA and were included in our study. The median age was 68 years (range: 41–92 years); 99 patients were male (66%) and 50 patients were female (34%). In the study cohort, 14 patients had a Rutherford stage 2 (9.4%), 111 patients stage 3 (74.5%), 11 patients stage 4 (7.4%) and 14 patients stage 5 and 6 (9.4%) (Table 1).

MR angiography

A 1.5 T Magnetom superconducting magnet (Siemens, Erlangen, Germany), with a moving table and a whole-body spiral for the lower legs, femoro-popliteal and aorto-iliacal vascular territory, was used to perform all of the MRAs.

Image interpretation

All of the MRAs were independently rated by four observers: a consultant of radiology (CR), a consultant of vascular surgery (CS), a resident of radiology (RR) and a resident of vascular surgery (RS), according to the TASC II classification for aorto-iliacal and femoro-popliteal lesions. Both of the consultants already had clinical experience for more than 15 years, and both of the residents a clinical experience for less than 5 years. Each MRA consisted of two evaluable vascular regions, namely the aorto-iliacal region, and the femoro-popliteal region (left and right segments). All of the observers were blinded to the clinical history of the patients and to the findings of the other observers. The regions that could not be rated by the examiner were entitled non-diagnostic (ND).

In a second pass, CR and CS obtained a consensus (C) by reviewing the angiograms together, which was used as the ‘gold standard’.

Analysis

Interobserver agreement for the morphological evaluation was quantified by using the weighted kappa coefficient (κ), according to Fleiss and Cohen.8 The κ values were reported with 95% CI for an assessment of the reliability between the observers themselves and between the observers and the consensus.9 The interobserver agreement was classified by

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n (%)</th>
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<tr>
<td>Median age</td>
<td>68 years</td>
</tr>
<tr>
<td>Male/Female</td>
<td>99/50 (66%/34%)</td>
</tr>
<tr>
<td>Smoking</td>
<td>101 (68%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>55 (37%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>73 (49%)</td>
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<tr>
<td>Hyperlipidaemia</td>
<td>54 (36%)</td>
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<tr>
<td>Coronary artery disease</td>
<td>31 (21%)</td>
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</table>

Conclusion: Although good results can be achieved in the assessment of vascular lesions according to the TASC II document, a simplification of this classification could increase its practicability in a daily clinical routine.
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A generalised estimation equation (GEE) model was used for a comparative assessment of the consensus agreement for the observers from vascular surgery and radiology, as well as the evaluations performed for the femoro-popliteal and aorto-iliac regions. In terms of this analysis, the estimates of the marginal probabilities of the consensus agreement and the corresponding ORs for the group comparisons were provided with 95% CI. Within the subject variables region, the experience level (consultant/resident) and profession (surgeon/radiologist) were considered simultaneously in the estimation of the OR.

The statistical significance of the differences in the ordinal ratings was assessed by the Wilcoxon test for paired samples, and the Mann–Whitney U-test for unpaired samples. A p value of ≤0.05 was considered to be indicative of statistical significance. The statistical analysis was performed using the SAS software (SAS System for Windows Version 9.2, SAS Institute Inc., Cary, NC, USA).

**Results**

A total of 300 arteriosclerosis-affected arterial segments (67.1%) of the 149 evaluated MRAs were assessed according to the TASC classification. These were subdivided into 101 aorto-iliac areas (33.7%) and 199 femoro-popliteal areas (66.3%) including right-sided 95 segments and left-sided 104 segments. According to the consensus between CR and CS, 78 TASC A lesions, 68 TASC B lesions, 27 TASC C lesions, 105 TASC D lesions and 21 ND were found. For TASC C lesions, the highest cumulative error ratio was found for all observers in comparison to the consensus with an average of 43.1% (Fig. 1). The results of the classifications, according to TASC II, for each observer, in comparison to the consensus regarding the aorto-iliac and femoro-popliteal regions, are shown in Figs. 2 and 3. There was a statistically significant overestimation of the TASC classification for the aorto-iliac region in comparison to the femoro-popliteal region (p < 0.001) that tended to an underestimation. This could be demonstrated for the cumulative data as well as for the residents (p < 0.001) and for the consultants (p < 0.001). No statistically significant difference was seen between the right and left femoro-popliteal segments.

**Figure 1** Percentage of false ratings of every observer and as mean values for TASC II grades A–D in comparison to the consensus (error ratio).

**Figure 2** Percentage of false and correct ratings for each observer in comparison to the consensus for the aorto-iliac region, shown as: underestimation, correct rating and overestimation (RR = resident radiology, RS = resident vascular surgery, CR = consultant radiology, CS = consultant vascular surgery).

**Figure 3** Percentage of false ratings for each observer in comparison to the consensus for the femoro-popliteal region, shown as: underestimation, correct rating and overestimation (RR = resident radiology, RS = resident vascular surgery, CR = consultant radiology, CS = consultant vascular surgery).

using the classification proposed by Altman: poor (k < 0.20), fair (k = 0.21–0.40), moderate (k = 0.41–0.60), good (k = 0.61–0.80) and excellent (k = 0.81–1.0). A 10% higher probability of the consensus agreement by region, experience level and profession. The GEE model evaluations of the femoro-popliteal region showed a 10% higher probability of the consensus agreement than did the aorto-iliac region (marginal agreement probabilities: 72% vs. 62%, OR: 1.64, 95%CI: 1.12–2.41, p = 0.012). In addition, comparison of the consensus agreement revealed a significantly better performance for the vascular surgeons than the radiologists (marginal agreement probabilities: 73% vs. 65%, OR: 1.43, 95%CI: 1.11–1.84, p = 0.006). Furthermore, the probability of a consensus agreement was higher for the consultants
compared with the residents (marginal agreement probabilities: 80% vs. 58%, OR: 2.86, 95%CI: 2.21–3.69, p < 0.001).

**Discussion**

In the Delphi consensus study for surgical or endovascular treatment for severe limb ischaemia, published by Bradbury et al., a substantial disagreement between, and also among, radiologists and surgeons was demonstrated. This disagreement could have been caused not only by the different medical specialities, but also by the different qualifications in evaluating angiograms. In addition, the four different TASC II grades for vascular lesions of the aorto-iliac, as well as the femoro-popliteal region, are based on several different elements, such as the type of lesion (stenosis or occlusion), number, length and localisation of the lesions. This illustrates that occasionally it may not be easy to make the correct evaluation of vessel pathology according to the TASC II classification. Up to now, no investigation about the practicability of this classification in the daily clinical routine has been made. Therefore, the aim of this study was to prove the reliability of evaluation with the TASC II classification for the aorto-iliac and femoro-popliteal vessels, since this is basic to proper therapeutic evidence- and guideline-based decisions.

In this study, we found that the TASC classification was applicable in the daily clinical routine of evaluating vascular pathologies for both surgeons and radiologists, regardless of their personal qualifications. Since every grade consists of a multitude of different factors, we believe that the daily clinical exposure with vascular diseases for the four observers had a positive influence on the results; the evaluations of less-experienced medical professionals may have resulted in a worse outcome.

However, the findings presume that the evaluation for the aorto-iliac segment is significantly more demanding than that for the femoro-popliteal segment (p = 0.012). Interestingly, the observers tended to significantly overestimate the vascular pathologies more often in the aorto-iliac than in the femoro-popliteal segment (p < 0.001). No conclusive reason for this overestimation can be given, except for an imbalance in the definitions of the TASC II classifications. Although the classification of the femoro-popliteal region also consists of several components, and might lead to misinterpretation, its applicability seems to be easier. This is emphasised by the fact that, only for the femoro-popliteal region, CS and CR achieved an excellent agreement in comparison to the consensus with κ > 0.8, whereas, for the aorto-iliac region, only one good and one moderate result (RR) was achieved.

A similar observation could be made with TASC II grade C. This grade showed a higher error ratio than the others. This is probably due to the fact that grade C is an in-between lesion with more fluent constraints and, therefore, is more difficult to classify.

The amount of clinical training seems to have a considerable impact on the ability to evaluate MRAs using the guidelines of the TASC II classification (p < 0.001). The same was demonstrated for the medical speciality, and there was a significantly better performance from the vascular surgeons (p = 0.006). This could probably be explained by the findings from the above-mentioned Delphi consensus study, which demonstrated that there was a significant difference in the choice of therapy between the radiologists and the vascular surgeons. The discrepancy is probably due more to a different opinion of the right therapy, than to a different diagnostic view of both medical specialities, since level I studies in this field are lacking. Only four prospective randomised studies for PAOD, comparing endovascular and surgical treatment, have been published so far. These have been summarised in a Cochrane review, and do not present distinct recommendations for therapy since PAOD has an extremely variable pathomorphological appearance. Therefore, further efforts are necessary to conduct new randomised controlled trials to deal with the question of what therapy is best for this disease, since only limited evidence exists for the efficacy of endovascular treatment.

One of the shortcomings of this study was that every observer category included only one physician. Therefore, the results could also be influenced by personal deficiencies, irrespective of medical speciality or clinical education. However, this feasibility study can give, for the first time, an impression of potential inadequacy of the TASC II classification for PAOD in daily clinical routine and may help to create a more balanced classification in the next TASC document. Since the intraobserver agreement seems to be high in the literature in similar studies, there was no second evaluation round performed, and thus, no statement about intraobserver variability can be made.

### Table 2 Interobserver agreement between different combinations for the MRA readings, expressed as k-values (with 95% CI). (RR = resident radiology, RS = resident vascular surgery, CR = consultant radiology, CS = consultant vascular surgery, C = consensus).

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<tr>
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<th>Aorto-iliac</th>
<th>Fem-pop</th>
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<tr>
<td>CR–CS</td>
<td>0.56 (0.45–0.68)</td>
<td>0.74 (0.66–0.81)</td>
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<tr>
<td>RR–RS</td>
<td>0.63 (0.51–0.75)</td>
<td>0.79 (0.72–0.87)</td>
</tr>
<tr>
<td>RR–C</td>
<td>0.51 (0.36–0.66)</td>
<td>0.54 (0.44–0.64)</td>
</tr>
<tr>
<td>RS–C</td>
<td>0.64 (0.51–0.76)</td>
<td>0.69 (0.60–0.79)</td>
</tr>
<tr>
<td>CS–C</td>
<td>0.64 (0.52–0.76)</td>
<td>0.87 (0.80–0.93)</td>
</tr>
<tr>
<td>CR–C</td>
<td>0.75 (0.64–0.86)</td>
<td>0.81 (0.73–0.89)</td>
</tr>
<tr>
<td>RR–CR</td>
<td>0.47 (0.31–0.62)</td>
<td>0.58 (0.47–0.68)</td>
</tr>
<tr>
<td>RS–CS</td>
<td>0.64 (0.52–0.76)</td>
<td>0.72 (0.63–0.81)</td>
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Figure 4 Probabilities of the consensus agreement by region, experience level and profession.
Conclusion

The morphological interpretation and categorisation of PAOD according to the TASC II classification varies among observers with a different level of education and different medical specialties. Within the limitations of this study, the aorto-iliac segment seems to be harder to evaluate and tends to be overestimated as regards the TASC II classification. Thus, further improvements are important to make generally accepted recommendations on the management of PAOD. In addition, more randomised controlled trials and level I evidence is needed. Simultaneously, a more compact and plain classification for the daily routine is required, so that non-vascular physicians also are able to make a proper grading of morphological changes in PAOD.

Conflict of Interest

The authors declare that they have no conflict of interest.

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References