Development of a preliminary US power Doppler composite score for monitoring treatment in PsA

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Abstract

Objective. To develop a preliminary power Doppler (PD) US composite score for global assessment of PsA patients.

Methods. Sixteen PsA patients receiving anti-TNF-α therapy were enrolled. All patients were involved in multiple psoriatic targets, including joints, tendon, enthesis, skin and nail. The target with the highest PD signal, one for each target area, was selected to be scanned at baseline and at follow-up visit 8 weeks after. For each target, PD was graded according to semi-quantitative scoring systems. Inter- and intra-observer reliability and feasibility was also investigated. The new PD composite score for PsA was called Five Targets PD for Psoriatic Disease (5TPD).

Results. Sixty targets (16 joints, 9 tendons, 11 enthesis, 16 psoriatic plaques and 8 psoriatic onychopathies) were assessed. A significant improvement of the clinical scores was found at follow-up with respect to the baseline: HAQ modified for SpA (HAQ-S) \( (P = 0.0001) \); Psoriasis Area and Severity Index \( (P = 0.0001) \) and Nail Psoriasis Severity Index \( (P = 0.35) \). The 5TPD showed a significant change between baseline and follow-up \( (P = 0.0001) \). There was no significant correlation between HAQ-S and 5TPD findings. The time spent on baseline US examinations was mean (s.d.) 10.5 (2.0) min and no more than 7 min for follow-up assessment.

Conclusion. The present study provides a new working hypothesis that the sonographic core set may be useful to construct a PDUS composite score for the assessment of PsA. The 5TPD formula provides a feasible and reliable approach for multi-target monitoring of psoriatic disease.

Key words: psoriatic arthritis, ultrasound, power Doppler, composite score, TNF-α antagonist.

Introduction

PsA is a chronic inflammatory disease with a widely variable intra- and inter-individual clinical course and outcome [1, 2]. Its heterogeneity is such that the term psoriatic disease has been recently suggested to encompass the involvement of different tissue levels, including joint, tendon, enthesis, skin and nail [3, 4].

A variety of clinical instruments are currently used for measuring the disease activity in patients with PsA, such as the Disease Activity Index for Psoriatic Arthritis (DAPSA), PsA Response Criteria (PsARC), Composite Psoriatic Disease Activity Index (CPDAI) and DAS using 28-joint count (DAS-28), which was originally developed for patients with RA [5-9]. Imaging findings have a valuable role to play in PsA; in spite of this, they are not firmly established in the assessment of treatment efficacy and monitoring of patient’s outcomes in daily clinical practice.

The International Group for Research and Assessment of Psoriasis and Psoriatic Arthritis (GRAPPA) [10] has recently underlined the importance of integrating clinical and imaging findings in PsA patients from a rheumatological and dermatological perspective.

There is an increasing body of evidence supporting power Doppler (PD) US as a sensitive imaging technique for the assessment of disease activity and therapy monitoring in patients with chronic arthritis, including PsA [11-16]. Moreover, the recent availability of probes with Doppler frequency >10 MHz, allows for the detection of
even minimal blood flow changes in different superficial tissues including nail and skin [17, 18].

To date, the potential of PDUS in the assessment of disease activity in PsA is clear. However, there is an absence of a standardized method in clinical practice for the composite evaluation of the multiple domains of the disease.

With the introduction of providing benefit from TNF-α antagonists that demonstrated efficacy at different musculoskeletal and dermatological targets, the quality of life for PsA patients has greatly improved [19, 20]. Moreover, such effective therapy allows for short-term testing of new methods to assess changes of disease activity in patients with inflammatory diseases.

Thus the purpose of the present study was to provide a model to develop a preliminary PDUS composite score for the assessment of blood flow changes induced by anti-TNF-α therapy in PsA patients at five target areas: joint, tendon, enthesis, skin and nail.

Materials and methods

Patients

Twenty-one PsA patients (14 males and 7 females) were consecutively enrolled in the study. Five patients were excluded since they were not available for the follow-up. Thus the results were obtained from a total of 16 patients (11 males and 5 females) with diagnosis of PsA according to the Classification of Psoriatic Arthritis (CASPAR) international criteria [21]. All patients were attending the outpatient and inpatient clinics of the Rheumatology Department of the Università Politecnica delle Marche (Ancona, Italy).

Inclusion criteria were age >18 years; active PsA disease despite several previous treatments including MTX or SSZ or ciclosporin; clinical involvement of at least three of the possible five psoriatic targets (joint, tendon, enthesis, skin and nail), including at least one musculoskeletal target and one dermatological target; and negative previous history of tuberculosis or TNF-α antagonist treatment. Patients were excluded if they had other active concomitant musculoskeletal diseases [such as gout or calcium pyrophosphate dihydrate crystal deposition disease (CPPD)] or inflammatory skin conditions, severe comorbidities, recent serious infection (in the month before the beginning of the study), positive pregnancy test at baseline for non-menopausal women and positive screening for tuberculosis according to Italian guidelines for biologic treatment [22]. Four weeks before the beginning of the study, local or systemic therapies including CSs, ultra-violet therapy, vitamin A and or D were discontinued.

Study design

Preliminary all clinically involved targets were scanned and those showing the highest expression of PD signal, one for each target area (joint, tendon, enthesis, skin and nail), were selected to be scanned at baseline and at follow-up visit (8 weeks after). Clinical and PD assessments were performed on the same day both at baseline and on follow-up visits.

All patients fulfilling the recruitment criteria started the anti-TNF-α therapy with adalimumab (40 mg s.c. every 2 weeks) or etanercept (50 mg s.c./week) or infliximab (5 mg/kg/infusion, administered at 0, 2, 6 and then every 8 weeks). Eleven patients received combined treatment with TNF-α therapy plus MTX (Table 1).

HAQ modified for SpA (HAQ-S), Psoriasis Area and Severity Index (PASI), Nail Psoriasis Severity Index (NAPSI) and PD examinations were performed on all patients during the same day at baseline and 8 weeks after the beginning of biologic treatment. The study was conducted according to the Declaration of Helsinki and local regulations. The institutional ethics committee (Comitato Etico dell’Azienda Sanitaria Unica Regionale di Ancona) approved the study and informed consent was obtained from all patients before performing PDUS examinations.

Clinical assessment

Before the PDUS assessment all patients underwent a complete clinical examination by the same rheumatologist (C.B.), which aimed to detect tenderness and or swelling at joints, tendons and entheses level. We used the Italian version of HAQ-S with culturally specific modifications in Italy [23]. The questions were explained in detail to all patients, who were asked to answer them at our clinic before and after treatment. Both psoriatic plaques and onychopathy were clinically assessed by an experienced dermatologist (G.F.), who also scored the PASI and NAPSI. The PASI was scored as follows: absence = PASI 0; mild = PASI < 10; moderate = PASI 10–20; marked = PASI > 20 [24]. NAPSI was calculated determining the presence or absence of nail bed psoriasis in four quadrants of each nail. An eight-point scale was used to grade the severity of nail psoriasis, yielding a maximum possible score in this system of eight per nail [25].

Development of composite PDUS score

A PD composite score for PsA called ‘Five Targets Power Doppler for Psoriatic Disease’ (STPD) (Table 2) was devised by a panel of five rheumatologists (M.G., L.D.G., E.F., F.S. and W.G.) and one dermatologist (G.F.) who has extensive experience in the field. Four of the five rheumatologists are experts in the use of US.

Once consensus was reached on the individual targets to be included in the PDUS composite score, definitions of domains and proposed scoring systems for each domain, investigators were asked to base their choice on both their clinical and ultrasonographic experience and knowledge. All investigators agreed that the components of the STPD should be selected from the five target areas involved in PsA, which are also accessible by PDUS. They include joint, tendon with synovial sheath, enthesis, skin and nail. The PD for each target was graded on the basis of the semi-quantitative scoring systems previously adopted: no, mild, moderate and severe grade (scoring from 0 to 3) for joint, tendon, enthesis and psoriatic plaque, respectively [11, 26–28]. Supplementary Fig. S1
Power Doppler monitoring of anti-TNF-α therapy in PsA

Table 1: Demographic, clinical and PDUS data, obtained at baseline and after 8 weeks of anti-TNF treatment

<table>
<thead>
<tr>
<th>Patient’s number</th>
<th>Age (months)</th>
<th>Sex</th>
<th>Disease duration (months)</th>
<th>Treatment</th>
<th>Joint</th>
<th>Tendon</th>
<th>Enthesis</th>
<th>Skin</th>
<th>Nail</th>
<th>5TPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient 1</td>
<td>16</td>
<td>M</td>
<td>3</td>
<td>Baseline</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>N/I</td>
<td>5</td>
</tr>
<tr>
<td>Patient 2</td>
<td>18</td>
<td>M</td>
<td>4</td>
<td>Baseline</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>N/I</td>
<td>5</td>
</tr>
<tr>
<td>Patient 3</td>
<td>24</td>
<td>F</td>
<td>5</td>
<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
<tr>
<td>Patient 4</td>
<td>30</td>
<td>M</td>
<td>1</td>
<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
<tr>
<td>Patient 5</td>
<td>36</td>
<td>F</td>
<td>2</td>
<td>Baseline</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>N/I</td>
<td>5</td>
</tr>
<tr>
<td>Patient 6</td>
<td>42</td>
<td>M</td>
<td>3</td>
<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
<tr>
<td>Patient 7</td>
<td>48</td>
<td>M</td>
<td>4</td>
<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
<tr>
<td>Patient 8</td>
<td>54</td>
<td>M</td>
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<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
<tr>
<td>Patient 9</td>
<td>60</td>
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<td>2</td>
<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
<tr>
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<td>66</td>
<td>M</td>
<td>3</td>
<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
<tr>
<td>Patient 11</td>
<td>72</td>
<td>F</td>
<td>4</td>
<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
<tr>
<td>Patient 12</td>
<td>84</td>
<td>M</td>
<td>1</td>
<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
<tr>
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<td>90</td>
<td>F</td>
<td>2</td>
<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
<tr>
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<td>M</td>
<td>3</td>
<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
<tr>
<td>Patient 15</td>
<td>104</td>
<td>M</td>
<td>4</td>
<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
<tr>
<td>Patient 16</td>
<td>112</td>
<td>F</td>
<td>5</td>
<td>Baseline</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>N/I</td>
<td>7</td>
</tr>
</tbody>
</table>

Δ: change in the score; N/I: target not involved.

Table 2: 5TPD

<table>
<thead>
<tr>
<th>Target area</th>
<th>Score range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint</td>
<td>0-3</td>
</tr>
<tr>
<td>Tendon</td>
<td>0-3</td>
</tr>
<tr>
<td>Enthesis</td>
<td>0-3</td>
</tr>
<tr>
<td>Skin</td>
<td>0-3</td>
</tr>
<tr>
<td>Nail</td>
<td>0-3</td>
</tr>
</tbody>
</table>

Maximal total score: 15

(available as supplementary data at Rheumatology Online) illustrates an example of a semi-quantitative score of PD signal at the psoriatic plaque level.

Since a minimal amount of blood flow may be occasionally detected in healthy nail beds, we scored the PD when there was a thickened nail bed (>3 mm), as previously suggested [18]. The scoring was as follows: 1 = confluent signal in <25% of the nail bed area; 2 = confluent signal in >25% and <50% of the nail bed area; 3 = confluent signal in >50% of the nail bed area. The maximum total score of 5TPD was 15, the sum of all five target PD scores (Table 2).

PDUS scanning technique

PDUS examinations were performed by an experienced rheumatologist sonographer (M.G.) blinded to clinical scores, using a MyLab 70 XVG (Esaote SpA, Genoa, Italy) equipped with a broadband frequency transducer ranging from 6 to 18 MHz and Doppler frequency ranging from 5.9 to 14.3 MHz according to the target.

PD settings were standardized at the following values: pulse repetition frequency (PRF) = 750 Hz, wall filter = 3 and Doppler frequency from 5.9 to 9.1 MHz (for joints, entheses and tendons) and from 11.1 to 14.3 MHz (for skin and nail). The value of the Doppler frequency used for the US examination at baseline was the one that allows obtaining the maximal expression of PD signal at the area of interest. The PD gain was set just below the level at
which colour noise appeared at underlying bone (no flow should be visualized at the bony cortex) [29]. The same PD settings were adopted for the follow-up assessment.

PDUS examinations of the musculoskeletal system were performed, adopting the indications provided by the European League Against Rheumatism guidelines for musculoskeletal US in rheumatology [30]. OMERACT preliminary definitions were adopted for the US pathological findings located at joint, tendon and enthesis [31].

Psoriatic skin and nail lesions were assessed by PDUS as follows: representative US images were acquired at both the centre and the margins of the psoriatic plaque lesion and the surrounding normal skin. Skin thickness varies among healthy subjects and depends on several aspects, including different areas of the body. Thus the thickness of the normal skin surrounding the psoriatic lesion was used as a reference for detecting the thickening of the epidermis and or the dermis. The totality of US evaluations was insonated on both longitudinal and transverse scans and perpendicularly using a large quantity of gel over the skin and nail to provide the correct acoustic interface. No stand-off was used. Particular attention was paid to applied pressure in order to avoid the blanching of PD signal due to compression by the transducer.

Inter- and intra-observer reliability
A second rheumatologist sonographer (M.T.), with 1 year of experience in musculoskeletal US, blinded with respect to the findings of the first sonographer (M.G.), carried out US examinations in all patients at baseline and follow-up in order to determine the inter-observer agreement in the assessment of semi-quantitative blood flow changes in all the five psoriatic targets studied. Before the study the investigators reached a consensus on which US scanning technique to adopt and on US findings and interpretations.

Intra-observer reliability was assessed by recording representative images of the full baseline and follow-up examination of all patients involved in the study. The stored images of each patient were blindly scored by the same investigator (M.G.) who successively performed the corresponding real-time US examinations the following day at both baseline and follow-up assessment. Moreover, the time spent on each patient for both baseline and follow-up visits were recorded.

Statistical analysis
Statistical analysis was performed adopting MedCalc (Mariakerke, Belgium) version 9.5.1 for Windows XP. Standard descriptive results were expressed as the mean or median (S.D.). The Mann-Whitney rank sum test was used for the comparison of the 5TPD findings obtained at baseline and at follow-up. The correlation between clinical and 5TPD scores was analysed by Spearman’s rank correlation test. P < 0.05 was considered significant.

Inter- and intra-observer reliability between the two investigators has been calculated in terms of semi-quantitative scoring by weighted k-statistic. A k-value of 0–0.20 was considered poor, 0.21–0.40 fair, 0.41–0.60 moderate, 0.61–0.80 good and 0.81–1.00 excellent.

Results
A total of 60 anatomical sites [16 joints (including 6 wrists, 8 MCP joints and 2 MTP joints), 9 tendons (including 4 finger flexor tendons, 4 tibialis posterior tendons, 1 peroneous tendons), 11 entheses (including 6 Achilles tendon, 3 distal and 2 proximal insertion of patellar tendon), 16 psoriatic plaques (all at anterior lower legs and posterior forearms level) and 8 psoriatic onychopathies (all at the hand nails level)] were assessed in 16 PsA patients. The mean (s.d.) for the age was 47.5 (7.6) years, range 32–63 years, and for the disease duration 40.5 (23.2) months, range 9–83 months. Table 1 shows demographic data, treatment, targets sonographically assessed, PDUS per target and total of 5TPD obtained at baseline and after 8 weeks of biologic treatment.

Clinical findings
With respect to the baseline, at follow-up examination clinical data improved and a significant decrease in scores was found: HAQ-S [mean (s.d.) 0.88 (0.20), range 0.5–1.1 vs 0.47 (0.12), range 0.25–0.63, respectively (P = 0.0001)]; PASI [mean (s.d.) 17.5 (5.3), range 10–28 vs 8.0 (2.7), range 4–14, respectively (P = 0.0001)]; NAPSI [mean (s.d.) 2.2 (2.6), range 0–6 vs 0.8 (1.0), range 0–3, respectively (P = 0.35)]. No patients required modification in their treatment dose during the 8 weeks of the study.

5TPD findings
5TPD showed a significant change between baseline and follow-up [median (range) 9 (4–12) vs 3 (1–5), respectively (P = 0.0001)]. PDUS changes before and after biologic treatment for any target were joint [median (range) 2.5 (1–3) vs 1 (0–2), respectively (P = 0.0001)], tendon [median (range) 2 (0–3) vs 0 (0–1), respectively (P = 0.040)], enthesis [median (range) 1.5 (0–3) vs 0 (0–2), respectively (P = 0.034)], skin [median (range) 3 (2–3) vs 0.5 (0–2), respectively (P = 0.0001)] and nail [median (range) 0.5 (0–2) vs 0 (0–2), respectively (P = 0.308)]. Fig 1 shows representative PDUS images obtained at baseline and at follow-up. Fig 2 shows the box plot representation of 5TPD, before and after the treatment.

Relationship between clinical data and 5TPD findings
There was no significant correlation between HAQ-S and 5TPD findings; r = 0.169, Spearman’s P = 0.51 at baseline; and r = 0.021, Spearman’s P = 0.93 at follow-up, respectively.

Inter- and intra-observer reliability and feasibility
The global k-values for the inter-observer reliability in the assessment of blood flow changes at five psoriatic targets during the baseline and follow-up varied from good to almost perfect, depending on the domain and scoring scale. At baseline the k-values were joint = 0.747, tendon = 0.791, enthesis = 0.974, skin = 0.880 and nail = 0.658, whereas at follow-up they were 0.787, 0.844, 0.895, 0.945 and 0.665 for joint, tendon, enthesis,
The $k$-values for the intra-observer reliability at baseline were joint = 0.985, tendon = 0.986, enthesis = 0.970, skin = 0.945 and nail = 0.828, whereas at follow-up they were 0.977, 0.986, 0.966, 0.904 and 0.812 for joint, tendon, enthesis, skin and nail, respectively.

The time spent on baseline US examinations by the more experienced investigator was mean 10.5 (2.0) min, range 7–15 min and no more than 7 min for follow-up assessment, whereas it was mean 13.8 (1.4) min, range 11–16 min for the baseline examination and <10 min for the follow-up examination for the second investigator (with less experience).

**Discussion**

To the best of the authors’ knowledge, this is the first study providing evidence about a multi-target monitoring of TNF-α antagonist therapy effect using a PD composite score on patients with PsA. The joint, tendon, enthesis, skin and nail involvement has been widely described by the different subsets criteria as aspects to be considered in the evaluation of disease activity.
The utility of PDUS in revealing abnormal perfusion indicative of disease activity at synovial and entheseal levels has been previously demonstrated in patients with chronic inflammatory diseases [11–16, 34–38]. Recently, we provided pictorial evidence about its potential in patients with PsA to allow a multi-target assessment of morphostructural and vascular changes at the joint, tendon, enthesis, skin and nail [39]. Moreover, a positive correlation was found between PDUS and histology findings at the psoriatic plaque level in patients receiving TNF-α antagonist therapy [26]. Taking into account the information listed above, we tested the possibility of using PDUS as a tool that is able to measure globally the inflammatory process by detecting perfusion changes induced by TNF-α antagonist.

Our results showed a significant improvement of 5TPD from baseline to 8 weeks of anti-TNF-α treatment. PDUS correlation at any single anatomical target was also significant with the exception of the onychopathy. This could be related to both the small number of patients with nail involvement (only eight patients) and the difficulty in discriminating between false positive or false negative within the nail bed, since it can be present also in healthy nails [18, 39].

A strong significance in improvement of PDUS was detected at joint and skin level, whereas the significance for the enthesis and tendons with synovial sheath was not strong. Although there is no US study that can support these findings, previous clinical trials stressed the fact that enthesitis and dactylitis require more time to reach a good response [19].

The 5TPD did not correlate with HAQ-S data. This phenomenon could be explained by the fact that PDUS is a sensitive tool for revealing even minimal changes in the superficial tissue perfusion that cannot be detected by clinical assessment. Moreover, PDUS provides independent data from the disability and function, which are measured by HAQ-S.

From further analysis of the results, the following additional considerations can be formulated. First, an increase of PD signal was found in no target areas in follow-up visits. Second, high 5TPD scores indicate a high inflammatory involvement of different psoriatic targets, thus important changes in its score provide information about the treatment benefit in different manifestations of psoriatic disease. Third, the assessment of a single target may underestimate the efficacy of the treatment. For instance, Patients 5 and 15 showed no changes at entheseal level, but in both of them evident reductions of 5TPD score, due to improvement of joint and skin, were found (Table 1). Finally, although the time to perform both the baseline and the follow-up examination is encouraging, it is important to consider that it was reached by an experienced sonographer who has extensive experience and confidence in the use of US for assessment of both psoriatic skin and nail.

This process has been a preliminary step in developing a composite PDUS for PsA. There are some limitations to this study: First, the small number of patients included does not permit an accurate evaluation in terms of sensitivity and specificity, which could support the data more strongly. Second, the longitudinal study was performed for only a short period of time. Third, the 5TPD was tested among the components of a single centre only. Fourth, the PDUS assessment was performed at a single anatomical site. Fifth only PD was considered as an indicator of treatment response. This was chosen on the basis of previous studies that demonstrated that the blood flow changes are more sensitive than morphostructural greyscale changes for short-term monitoring response to therapy [11–16, 40–42]. Sixth, an accurate assessment of blood flow changes in the different tissues, especially in superficial small joints, psoriatic skin and onychopathy requires US equipment with a very high-frequency Doppler. The final limitation of this approach is the ceiling effect. In fact, high scores of 5TPD denote the involvement of multiple target areas of psoriatic disease, and they can be shared by patients with relevant differences in terms of the extent of the inflammatory involvement at each specific target area. In other words, severe inflammation of a single joint showing a PD grade of 3 already gives the maximal contribution to the final score; an equally severe, but polyarticular involvement cannot provide >3, being not adequately represented and easily underestimated. Steps aimed at defining a linear cut-off
value for any single domain of 5TPD could resolve this aspect.

This formula was designed to address the challenging purpose of monitoring psoriatic disease activity in daily practice after a complete clinical examination, not to replace other well-established and accepted US assessments. A relevant and fast decrease in the 5TPD score may indicate sustained improvement of psoriatic disease and help the clinician in making treatment decisions in daily practice.

Conclusion

The result of this study provides a new working hypothesis that the sonographic core set may be useful to construct a PDUS composite score for the assessment of PsA. The 5TPD formula provides a feasible, reliable and comprehensive approach for multi-target monitoring of psoriatic disease. Ongoing investigation is further assessing the advantages and limitations of this formula in a wider cohort of patients, testing also its concurrent validity, responsiveness, as well as a study comparing the 5TPD with the recently proposed clinical composite indexes as a more objective measure of disease activity.

Rheumatology key messages

- The 5TPD composite score provides a feasible, reliable and comprehensive approach to multi-target monitoring of PsA.
- A decrease in 5TPD score may indicate sustained improvement of PsA and help the clinician in making treatment decisions.
- PDUS is able to measure globally the perfusion changes induced by TNF-α antagonist in PsA.

Disclosure statement: The authors have declared no conflicts of interest.

Supplementary data

Supplementary data are available at Rheumatology Online.

References

22. Salvarani C, Olivieri I, Cantini F et al. [Recommendations for the appropriate use of anti-TNFalpha therapy in