Author/s:
Joshua, F;Bailey, C;Marabani, M;Romas, E;White, R;Wong, P

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Perceptions of Doppler ultrasound for rheumatoid arthritis disease activity assessment and education

Running title

Ultrasound in rheumatoid arthritis

Authors

Fredrick Joshua, Christine Bailey, Mona Marabani, Evange Romas, Raymond White, Peter Wong

Author affiliations

Fredrick Joshua

Combined Rheumatology Practice and Macquarie University, Sydney, NSW, Australia

Christine Bailey

AbbVie Australia, Sydney, NSW, Australia

Mona Marabani

Private Rheumatology Practice, Campsie, NSW, Australia

Evange Romas

Department of Medicine, University of Melbourne, Melbourne, VIC, Australia

Raymond White

Private Rheumatology Practice, Campbelltown, NSW, Australia

Peter Wong

Mid-North Coast Arthritis Clinic and UNSW Rural Clinical School, Coffs Harbour, NSW, Australia

Author contributions

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- **Study concept and design:** Fredrick Joshua, Mona Marabani, Evange Romas, Raymond White, Peter Wong
- **Acquisition of data:** Christine Bailey, Evange Romas, Raymond White, Peter Wong
- **Analysis and interpretation of data:** Fredrick Joshua, Christine Bailey, Mona Marabani, Evange Romas, Raymond White, Peter Wong
- **Initial drafting of the manuscript**: Fredrick Joshua, with assistance from Hazel Palmer and Adrianna Kalous of Scriptix Pty Ltd
- **Critical revision of the manuscript for important intellectual content**: Fredrick Joshua, Christine Bailey, Mona Marabani, Evange Romas, Raymond White, Peter Wong

Corresponding author

A/Professor Fredrick Joshua

Suite G3, 64 Talavera Rd

Macquarie Park NSW 2113

Telephone: +61 (02) 9888 9798

Email: fredjoshua@unsw.edu.au

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ABSTRACT

Aim: The aim of this qualitative study was to report the findings of the **DE**fining rheumatoid arthritis progression using **D**oppler **U**ltrasound in **C**linical practic**E** (DEDUCE) Medical Practice Activity, which was developed to facilitate the utilization of Doppler ultrasound (DUS) by Australian rheumatologists in the treatment of patients with rheumatoid arthritis (RA).

Method: Twenty-one rheumatologists recruited a total of 80 patients with RA in Disease Activity Score 28 (DAS28) remission for DUS assessment and completed a pre- and post-activity questionnaire assessing their experience with DUS, as well as a 6-month follow-up questionnaire. Rheumatologists discussed DUS results with patients using visual aids. Patients completed a pre- and post-DUS assessment questionnaire. Data were summarized using descriptive statistics.

Results: Following completion of the activity, 95% of rheumatologists (20/21) believed DUS was a useful assessment tool for patients with RA. The majority found the DUS results useful and more than half thought the DUS assessment fit well into their consultation. A majority of rheumatologists indicated they would use DUS imaging in patients with low disease activity and remission, and for disease activity assessment to inform in therapeutic decision-making. All patients who responded found the visual aids useful and most felt that discussing DUS results improved understanding of their disease and would help with medication adherence.

Conclusion: Incorporation of DUS imaging into routine clinical practice is feasible, encourages rheumatologists to utilize and expand their clinical application of DUS imaging in patients with RA, and may improve patient understanding of their disease and adherence to medication.

Keywords: rheumatoid arthritis; remission; Doppler ultrasound; imaging; patient education; attitudes.

INTRODUCTION

Doppler ultrasound (DUS) can detect active synovitis and predict joint destruction, flare, and short-term relapse in patients with rheumatoid arthritis (RA) who meet clinical remission criteria.[1-5] As synovitis often results in joint damage,[6] subclinical synovitis may lead to disease flare and may help explain the progressive joint damage that is observed even in patients who appear to be in clinical remission.[7-10] DUS may therefore be an important tool to improve assessment of disease activity and aid in disease management decisions.[2,11,12]

Doppler ultrasound is a non-radioactive, portable, relatively inexpensive imaging technique that is acceptable to patients and allows real-time imaging in multiple planes.[13] Despite these advantages and growing interest in its use, musculoskeletal ultrasonography is frequently under-utilized by rheumatologists,[14-18] with lack of training among the most commonly cited reasons.[19-21]

Doppler ultrasound may also be useful as a patient education tool to improve both patient understanding of their disease and medication adherence. Showing patients with RA real-time DUS images of their inflamed joints on one occasion increased their belief in the necessity of medication (versus concern about taking medication).[22] The visual nature of DUS may be important in patient education, as real-time demonstration of joint structures and damage and the ability to highlight critical features for patients using their own anatomy may improve understanding and help patients recognize the need for medication.[23]

The purpose of this study was to report the findings of the **DE**fining rheumatoid arthritis progression using **D**oppler **U**ltrasound in **C**linical practic**E** (DEDUCE) Medical Practice Activity. This study was developed to facilitate the utilization of DUS by Australian rheumatologists as part of routine assessment and ongoing evaluation of therapy in patients with RA. The objectives of the present study were to assess: 1) the current use of DUS by Australian rheumatologists, 2) the feasibility of incorporating a single DUS assessment into routine clinical practice to measure RA disease activity in patients who are considered to be in remission as measured using the Disease Activity Score 28 (DAS28), 3) whether exposure to

DUS altered rheumatologists' attitudes and clinical practice, and 4) whether DUS assessment improved patient understanding of their RA and medication adherence.

METHODOLOGY

Participants

The DEDUCE Medical Practice Activity was open to all Australian rheumatologists who use DUS directly themselves, have access to DUS in-practice, or can access DUS from external ultrasonography practices. Each participating rheumatologist recruited 4 to 6 patients for DUS assessment. To be included in the study, patients had to meet the following inclusion criteria: aged ≥18 years; having a diagnosis of RA and seeing a rheumatologist every 3 months; currently classified as being in DAS28 remission (DAS28 score <2.6). There were no criteria regarding which joints were involved.

The study was approved by the Bellberry Human Research Ethics Committee (Eastwood, South Australia) and was performed in accordance with the Declaration of Helsinki. All patients included in the study provided written informed consent to the collection and use of anonymous survey data to support future publications.

Study design

Prior to enrolling patients, participating rheumatologists completed a pre-activity questionnaire assessing their DUS experience. Eligible and consenting patients completed a pre-assessment survey to assess their current knowledge before the consultation with their rheumatologist. Rheumatologists then incorporated a DUS assessment into the consultation, either within the practice or by referral to an external ultrasonography practice. The joints evaluated were determined by the rheumatologist based on the patient's joint involvement and were therefore different for each patient. Rheumatologists discussed the patient's DUS imaging results with them in conjunction with specifically developed visual aids to help with patient interaction. The visual aids consisted of DUS photograph examples showing various levels of synovitis (Figure 1). After DUS assessment, patients completed a post-assessment questionnaire. Rheumatologists completed a post-activity questionnaire after all enrolled patients had been assessed, as well as a 6-month follow-up survey, each assessing experience and attitudes toward the use of DUS imaging.

All patient data were de-identified by assigning a unique identification number to each enrolled patient. Anonymous patient data were stored and analyzed in line with ethical requirements.

Statistical analyses

All data from rheumatologist and patient questionnaires were analyzed using descriptive statistics.

RESULTS

Characteristics of enrolled rheumatologists and participating patients

Characteristics of the 21 rheumatologists who participated in DEDUCE are summarized in Table 1. Approximately 70% of rheumatologists had experience with the use of DUS imaging for the assessment of RA activity, either through performing it themselves within the practice or by referring patients to an external ultrasonography practice. Characteristics of the 80 patients who completed the pre-assessment survey are summarized in Table 2.

Current DUS use

Among the 15 rheumatologists who had experience with the use of DUS imaging, the most common application was as a diagnostic tool to confirm the diagnosis of early RA, followed by assessment of disease activity to inform therapeutic decisions (Table 3). DUS imaging was mainly used to measure disease activity in patients with low disease activity (Table 3). All 15 rheumatologists routinely discussed DUS imaging results with their patients. Most rheumatologists already believed that utilizing DUS to assess RA in patients aided in therapeutic decision-making and communication with patients (Table 3). Fewer believed that the use of DUS aided in patient adherence with therapy.

The most common reasons for not using DUS by rheumatologists were inconvenience to patients (4/6; 66.7%), expense to patients (3/6; 50%), concerns about the utility of DUS reports (3/6; 50%), lack of benefit/unnecessary (2/6; 33.3%), and other reasons (1/6; 16.7%).

Utility of DUS assessment in routine clinical practice

Most rheumatologists found the results of DUS imaging useful; 9 of 21 rheumatologists (42.9%) found the results very useful, 7 rheumatologists (33.3%) found the results somewhat useful, and 5 rheumatologists (23.8%) were undecided. More than half of the rheumatologists found that DUS assessment integrated into their usual consultation very well (4/21; 19%) or quite well (8/21; 38.1%). Only 4 rheumatologists (19%) found that it did not fit well, 4 (19%) were undecided, and 1 did not provide a response. Most rheumatologists (19/21; 90.5%) discussed the DUS imaging results with their patients. Of these rheumatologists, most found the patient visual aids useful (8/19 [42.1%] found them very useful, 8/19 [42.1%] found them somewhat useful, and 3/19 [15.8%] were undecided).

Sixty-six patients completed the post-assessment survey. Of these patients, 61 indicated that their rheumatologist used the visual aids to explain the use of DUS. All patients who responded found the visual aids useful to some extent (very useful, 27 [44.3%]; useful, 23 [37.7%]; somewhat useful, 3 [4.9%]; a little useful, 3 [4.9%]).

Impact of DUS assessment on clinical practice and clinician attitudes

Six months following completion of the DEDUCE study, all except 1 rheumatologist considered DUS useful for the assessment of patients with RA (very useful, 14/21 [66.7%]; somewhat useful, 6/21 [28.6%]; undecided, 1/21 [4.8%]). Nineteen of 21 rheumatologists (90.5%) had incorporated DUS into their usual consultation routine; 11 rheumatologists (52.4%) had referred more than 10 patients to DUS, 8 (38.1%) had referred 1 to 10 patients, and 2 (9.5%) had not referred any patients. Most rheumatologists were either trained in DUS imaging (14/21; 66.7%) or intended to pursue training (4/21; 19.0%). The most common way rheumatologists planned to implement DUS imaging into clinical practice was by performing it themselves (18/21; 85.7%), followed by referring patients externally (2/21; 9.5%) and utilizing a trained dedicated rheumatologist (1/21; 4.8%). In a separate question, however, 1 rheumatologist (4.8%) said that he would not continue to use DUS imaging for the assessment of RA.

At the time of enrollment, no rheumatologists used DUS imaging to facilitate patient discussion and only one third of rheumatologists used DUS imaging for the assessment of disease activity to inform in therapeutic decision-making; 6 months after completing DEDUCE,

66.7% and 95.2% of rheumatologists, respectively, believed these were appropriate applications of DUS imaging (Table 3).

The proportion of rheumatologists who believed that utilizing DUS to assess patients with RA aided therapeutic decision-making and patient communication was unchanged (Table 3). Few rheumatologists believed inconvenience, expense, concerns about DUS utility, lack of benefit/unnecessary, or other were reasons not to use DUS (3/21 [14.3%], 1/21 [4.8%], 1/21 [4.8%], 2/21 [9.5%], and 1/21 [4.8%], respectively).

Impact of DUS assessment on patient attitudes

Most patients who completed the post-assessment questionnaire agreed that DUS imaging was a useful tool in assessing disease activity in RA (strongly agree, 37/66 [56.1%]; agree, 19/66 [28.8%]; undecided, 8/66 [12.1%]; no response, 2/66 [3.0%]). Of the 58 patients (87.9%) who said their rheumatologist discussed the DUS imaging results with them, most agreed or strongly agreed that this improved understanding of their disease (strongly agree, 32/58 [55.2%]; agree, 19/58 [32.8%]; undecided, 7/58 [12.1%]) and would improve their adherence with medications (strongly agree, 27/58 [46.6%]; agree, 28/58 [48.3%]; undecided, 3/58 [5.2%]).

DISCUSSION

This small qualitative report of the findings of the DEDUCE Medical Practice Activity suggests that the incorporation of DUS assessment into routine clinical practice to measure RA disease activity is useful and feasible. The Medical Practice Activity promoted rheumatologist uptake of DUS, with the majority of rheumatologists having incorporated DUS into their usual consultation routine within 6 months. Most rheumatologists planned to implement DUS by performing it themselves. Rheumatologists commonly state that lack of training is a barrier to the uptake of musculoskeletal US in routine clinical practice.[19-21] This study suggests that exposure to DUS encourages rheumatologists to implement DUS into their practice.

The use of DUS helps inform in therapeutic decision-making.[12,24] The most striking change in rheumatologists' attitudes toward DUS after completing the Medical Practice Activity was an increase in the belief that DUS imaging is appropriate for disease activity assessment to inform in therapeutic decision-making. Exposure to DUS through the Medical

Practice Activity also appeared to alleviate rheumatologists' concerns about the utilization of DUS, particularly the potential inconvenience and expense to patients and concerns about the utility of DUS reports.

There is increasing evidence that power DUS detects low but clinically significant levels of RA disease activity in patients who appear to be in clinical remission. It has even been proposed that DUS imaging should be a component of remission criteria.[2,11,12] An international study (TURA, NCT02056184) designed to determine whether targeted DUS improves RA outcomes in patients in disease remission is currently being conducted.

The use of DUS imaging for disease activity assessment in patients in remission was uncommon among the rheumatologists enrolled in the Medical Practice Activity. However, almost 60% of rheumatologists regarded this as an appropriate application of DUS after completing the activity. Thus, exposure to DUS appeared to improve rheumatologists' knowledge of appropriate applications for DUS imaging. It should be noted, however, that participants were not randomly recruited and therefore the results may be affected by selection bias.

Medication adherence in patients with RA is suboptimal, varying from 30 to 80%.[25] This is a complex issue and is impacted by patient knowledge and beliefs about their disease.[25,26] There are few published data regarding the effect of musculoskeletal US on patient understanding and adherence to medication.[22] This study suggests discussing DUS imaging results with patients may facilitate patient understanding and adherence to medication. However, this was a small qualitative study with no objective measure of patient understanding and medication adherence. It is also possible that there may have been a selection bias for patients with positive attitudes towards DUS imaging to complete the post-assessment questionnaire, which may have resulted in an overestimation of the positive impact of discussing DUS imaging results. Nevertheless, our findings should encourage further research regarding the utility of DUS as a patient educational tool.

The educational potential of DUS assessment may be limited when imaging is performed externally, as the treating rheumatologist is not present to contemporaneously explain to patients the significance of observed changes. Therefore, rheumatologists were asked to use specific visual aids to help explain DUS imaging to patients. Most rheumatologists, and all patients who responded, felt the visual aids were useful. Although there was no control group to enable evaluation of the impact of the visuals aids on patient attitudes towards

understanding of disease and medication adherence, these findings warrant future investigation of the use of visual aids to enhance the educational value of musculoskeletal DUS.

A secondary objective of the study was to evaluate the impact of prior DUS imaging on clinician and patient knowledge and attitudes. Although subgroup comparisons were not feasible due to the small sample sizes, a similar proportion of rheumatologists with DUS experience found the DUS imaging results useful, regardless of whether they performed the imaging themselves or referred patients externally (data not shown). In addition, most patients believed that discussing the DUS results helped them to better understand their disease and would help them adhere to their medications, regardless of whether their rheumatologist performed the imaging themselves or referred them to an external radiologist (data not shown). These observations suggested that DUS imaging need not be performed by the rheumatologist, as benefit was demonstrated even when the imaging was performed externally.

In summary, this study provides qualitative evidence that incorporating a single DUS assessment into routine consultation encourages rheumatologists to implement DUS imaging and positively impacts clinical practice. A prospective quantitative study is needed to confirm these findings. In addition, the findings suggest that DUS imaging is potentially a useful patient educational tool.

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Table 1. Baseline characteristics of rheumatologists (n=21)

Characteristic	n (%)
Years since qualification as a rheumatologist	
<5 years	10 (47.6)
5–10 years	2 (9.5)
>10 years	9 (42.9)
Single practice/group practice	9 (42.9)/12 (57.1)
Public practice/private practice	18 (85.7)/3 (14.3)
Access to specialist nursing support	10 (47.6)
Approximate number of RA patients treated per month	
<10	11 (52.4)
10–50	4 (19.0)
50–100	3 (14.3)

>100	2 (9.5)
No response	1 (4.8)
Number of rheumatologists who use validated assessment tools to	
Measure RA disease activity and response to therapy	17 (81.0)
Measure patient quality of life	10 (47.6)
Current or previous utilization of DUS imaging for assessment of RA activity	
Performed within the practice	8 (38.1)
Patients referred to external radiologist	7 (33.3)
Never used DUS	6 (28.6)

DUS, Doppler ultrasound; RA, rheumatoid arthritis.

Table 2. Characteristics of participating patients (n=80)

Characteristic	n (%)
Age, years	
<50	20 (25.0)
50 to <60	24 (30.0)
60 to <70	22 (27.5)
≥70	14 (17.5)
Female	66 (82.5)
Years since diagnosed with RA	
≤2	26 (32.5)

>2 to ≤5	7 (8.8)
>5 to ≤10	16 (20.0)
>10	29 (36.3)
Unknown	2 (2.5)
Previous DUS imaging for assessment of RA	19 (23.8)

DUS, Doppler ultrasound; RA, rheumatoid arthritis.

Table 3. Rheumatologist attitudes and utilization of DUS imaging at enrollment and 6 months post-activity, n (%)

Questions	Time of enrollment (n=15)[†]	6 months post-activity, (n=21)[‡]
Reasons rheumatologists had requested/would request DUS imaging for assessment of an RA patient[§]		
Diagnostic tool to confirm inflammatory RA	9 (60.0)	–
Disease activity assessment to inform therapeutic decisions	5 (33.3)	20 (95.2)

[†] Data for time of enrollment was collected only from rheumatologists who had previous experience with the use of DUS imaging.

[‡] Data for 6 months post-activity was collected from all rheumatologists.

[§] Responses at time of enrollment reflect rheumatologists' actual clinical practice ("had requested"), whereas responses 6 months post-activity reflect rheumatologists' attitudes ("would request") toward the use of DUS imaging. Rheumatologists could select more than 1 answer.

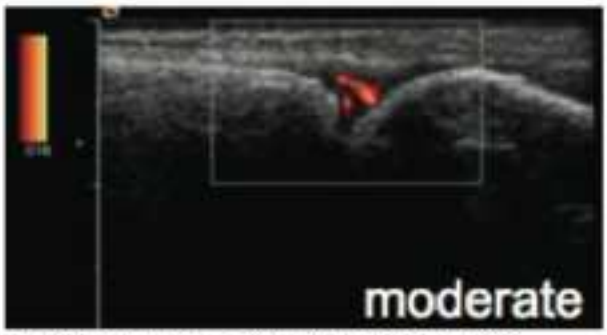
Disease activity assessment to facilitate patient discussion	0	14 (66.7)
Other	1 (6.7)	3 (14.3)
Rheumatologists who had requested/would request DUS imaging to measure disease activity in RA patients with[§]		
Disease remission	4 (26.7)	12 (57.1)
Low disease activity	10 (66.7)	18 (85.7)
Moderate disease activity	2 (13.3)	5 (23.8)
Severe disease activity	0	6 (28.6)
Other patients	0	2 (9.5)
Rheumatologists who believed in utilizing DUS to assess RA patients aids		
Therapeutic decision-making	13 (86.7)	19 (90.5)
Communication with your patient	12 (80.0)	17 (81.0)
Patient adherence and compliance with therapy	9 (60.0)	–

DUS, Doppler ultrasound; RA, rheumatoid arthritis

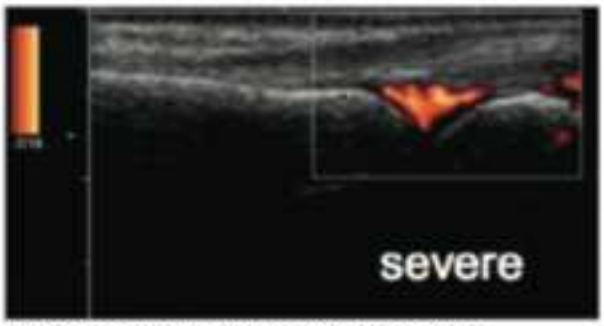
FIGURE LEGEND

Figure 1. Example of the patient visual aids.

DUS images: mild inflammation (low blood flow, low disease activity)
This image shows a patient with mild joint inflammation.



DUS images: moderate inflammation (medium disease activity)
This image shows a patient with moderate joint inflammation.



DUS images: severe inflammation (high blood flow, high disease activity)
This image shows a patient with severe joint inflammation. The colours in this picture tell your rheumatologist that blood flow is high which indicates that this joint is severely inflamed.

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