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Concise Report

Efficacy of hydrotherapy in fibromyalgia syndrome—a meta-analysis of randomized controlled clinical trials

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Objective. To systematically review the efficacy of hydrotherapy in FM syndrome (FMS).
Methods. We screened MEDLINE, PsychInfo, EMBASE, CAMBASE and CENTRAL (through December 2008) and the reference sections of original studies and systematic reviews on hydrotherapy in FMS. Randomized controlled trials (RCTs) on the treatment of FMS with hydrotherapy (spa-, balneo- and thalassotherapy, hydrotherapy and packing and compresses) were analysed. Methodological quality was assessed by the van Tulder score. Effects were summarized using standardized mean differences (SMDs).
Results. Ten out of 13 RCTs with 446 subjects, with a median sample size of 41 (range 24–80) and a median treatment time of 240 (range 200–300) min, were included into the meta-analysis. Only three studies had a moderate quality score. There was moderate evidence for reduction of pain (SMD −0.78; 95% CI −1.42, −0.13; $P < 0.0001$) and improved health-related quality of life (HRQOL) (SMD −1.67; 95% CI −2.91, −0.43; $P = 0.008$) at the end of therapy. There was moderate evidence that the reduction of pain (SMD −1.27; 95% CI −2.15, −0.38; $P = 0.005$) and improvement of HRQOL (SMD −1.16; 95% CI −1.96, −0.36; $P = 0.005$) could be maintained at follow-up (median 14 weeks).
Conclusions. There is moderate evidence that hydrotherapy has short-term beneficial effects on pain and HRQOL in FMS patients. There is a risk to over-estimate the effects of hydrotherapy due to methodological weaknesses of the studies and to small trials included in meta-analysis.

Key words: Fibromyalgia syndrome, Hydrotherapy, Spa therapy, Balneotherapy, Systematic review, Meta-analysis.

Introduction

Hydrotherapy is one non-pharmacological therapy of FM syndrome (FMS) used by up to 75% of the patients [1, 2]. The use of water for medical therapy dates back to ancient cultures from China, Japan and Europe. Balneotherapy (drinking of and/or bathing in medicinal water, bathing in warm or cold water or mud) and spa therapy (drinking of and/or bathing in thermal or mineral water) are different forms of hydrotherapy.

Two qualitative systematic reviews were conducted on the efficacy of hydrotherapy in FMS, which searched the literature until July 2006 [3] and December 2006 [4], respectively. One review included only trials published in English language [3]. In the meantime, further studies on hydrotherapy in FMS have been published, which were not included in systematic reviews so far. To our knowledge, a meta-analysis providing effects sizes of hydrotherapy was not published yet. The aim of our review therefore was to determine the efficacy of hydrotherapy in FMS by updating the search without language restrictions and by a quantitative analysis of data.

Methods

Meta-analysis was performed according to the QUORUM (quality of reporting meta-analyses) guidelines [5].

Data sources and searches

The electronic bibliographic databases screened included MEDLINE, PsychInfo, SCOPUS, the Cochrane Central Register of Controlled Trials (CENTRAL) and CAMBASE (through December 2008). The search strategy for MEDLINE is detailed in supplementary Table 1 (available as supplementary data at *Rheumatology* Online). The search strategy was adapted for each database if necessary. In addition, reference sections of original studies, qualitative systematic reviews on hydrotherapy in FMS [3, 4] and evidence-based guidelines on the management of FMS [6–8] were screened manually. No language restrictions were made.

Study selection

Studies were required to meet the following criteria: (i) any kind of hydrotherapy without exercise; (ii) diagnosis of FMS based on recognized criteria; (iii) randomized controlled trials (RCTs) comparing hydrotherapy with any other intervention or with no intervention; (iv) at least one symptom-specific outcome of the 'key symptoms' of FMS such as pain, fatigue, sleep disturbances, depressed mood and health-related quality of life (HRQOL) [9]; and (v) publication of the study in full paper form.

Data extraction

Two authors screened the titles and abstracts of potentially eligible studies identified by the search strategy detailed above independently. The full text articles were then examined independently by two authors to determine if they met the selection criteria. For the preparation of the meta-analysis, two of the four authors independently extracted data (study characteristics and study results) using standard extraction forms.

Assessment of external validity

The external validity (representativeness of study samples for the FMS population in clinical practice and safety of treatment) was checked by analysing the inclusion and exclusion criteria, the

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socio-demographic and medical data of the study samples, the settings and referrals of the RCTs and the side effects reported.

Assessment of methodological quality

The methodological quality was assessed by the van Tulder score using 11 items. We arbitrarily classified methodology as high (score 8–11), moderate (score 5–7) or low quality (score 1–4) [10]. We used the following modified levels of evidence descriptors to classify the results of the meta-analysis: strong: consistent findings in at least three moderate quality RCTs; moderate: consistent findings in at least three RCTs with at least one moderate RCT; limited: consistent findings in two low-quality RCTs; conflicting: inconsistent findings among multiple RCTs; no evidence: one or no RCTs [10].

Dealing with missing data

We contacted authors of studies in case of missing data in the publication. If the S.D. (post) was not reported and not provided on request, the missing S.D. (post) was substituted by the mean of the S.D. (post) of the other studies if the outcome was reported by at least three studies on the same scale.

Data analysis

For the comparison of proportions the chi-squared test was applied. Non-parametric tests (Mann–Whitney U-test) were used for the comparison of continuous variables. A two-sided *P*-value of $\leqslant 0.05$ was considered significant. Meta-analyses were conducted using RevMan Analyses software (RevMan 5.0.17) of the Cochrane Collaboration [11].

Standardized mean difference (SMD) as effect measure was used by calculating SMD by means and S.D. or change scores for each intervention. For the calculation of SMDs, the data of at least two studies should be available. Examination of the combined results was performed by a random effects model, because this model is more conservative than the fixed effects model and incorporates both within-study and between-study variance [12]. SMD used in Cochrane reviews is the effect size known as Hedges (adjusted) *g*. We used Cohen's categories to evaluate the magnitude of the effect size, calculated by SMD, with $g > 0.2$–0.5, small effect size; $g > 0.5$–0.8, medium effect size; and $g > 0.8$, large effect size [13].

Assessment of publication bias

Potential publication bias was intended to investigate by visual assessment of the funnel plot (plots of effect estimates against sample size) [14] calculated by RevMan Analyses software. Furthermore, we tested the sensitivity of our results to potential unpublished studies using a file drawer test for meta-analysis. This test determines how many negative studies with an effect size of $d = 0.01$ would be needed to negate our findings (fail-safe-N) [15]. If fail-safe-N > file-drawer N ($5k + 10$; k, number of studies meta-analysed), the results of the meta-analysis can be regarded as robust against potential reporting bias [16].

Assessment of heterogeneity

Heterogeneity was tested using the chi-squared test with a *P*-value conservatively set at 0.1 and the I^2-statistic with I^2-values >50% indicating strong heterogeneity [17].

Subgroup analyses

Where at least two studies were available, subgroup analyses were performed for type (thermal bath *vs* other types) and intensity of hydrotherapy (200 *vs* > 200 min), co-therapies (allowed or not), control group (active therapy *vs* no therapy or treatment as usual), setting (outpatients *vs* inpatients) and sex ratios (only women *vs* mixed sample). These subgroup analyses were also used to examine potential sources of clinical heterogeneity.

Sensitivity analysis

Sensitivity analyses were planned by removing studies based on the following methodological quality criteria: inadequate randomization, no allocation concealment, drop out rate >20% in treatment group or not reported, low-quality score and missing values substituted for the calculation of effect sizes. These sensitivity analyses were also used to examine potential sources of methodological heterogeneity.

Results

Study selection

The literature search produced 96 citations involving FMS, hydrotherapy and RCTs, 13 of which met initial inclusion criteria (Fig. 1). On more detailed review of these 13 initially selected articles, further three papers were excluded for the following reasons: one study, because means and/or S.D. of pre-test and post-test data were not included in the publication, and were not provided by the authors on request and could not be calculated [18]; one study because the outcomes assessed did not meet the inclusion criteria [19]; and one study because of double

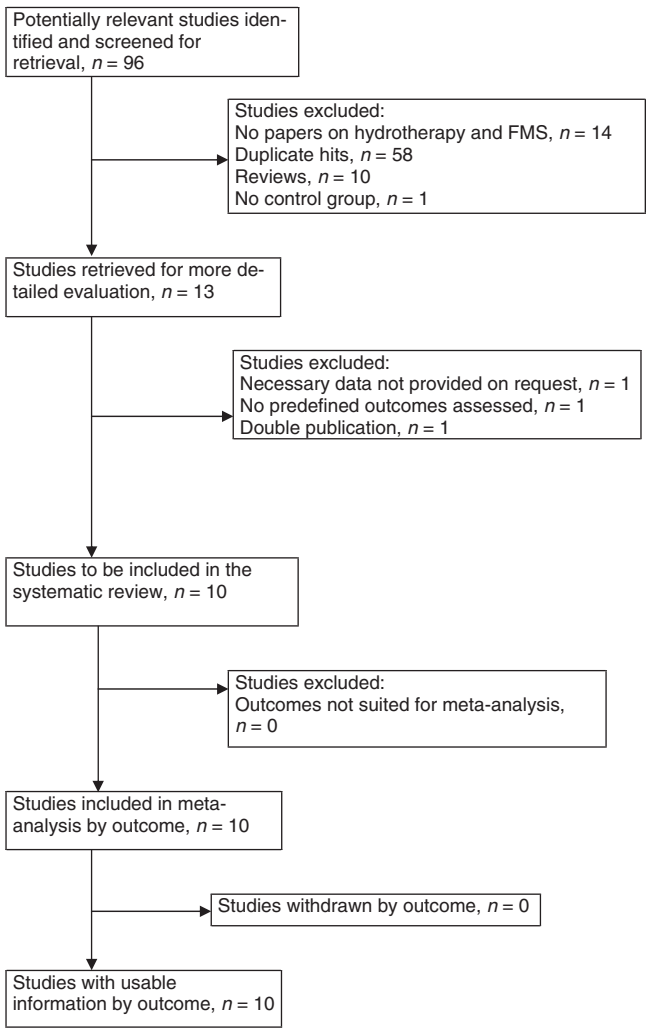

FIG. 1. QUORUM flow diagram.

TABLE 1. Main characteristics of studies with hydrotherapy

Reference Country Setting Referral	Mean age, years Women, % Race, %	Methodological quality Van Tulder score	Diagnosis of FMS Exclusion criteria	Inclusion criteria Comorbidities assessed and reported	Study population No. of patients screened/ randomized, %	Study population Total number/ no. of patients completing, *n*/*n*, %	Treatment group Total number/ no. of patients completing, *n*/*n*, %	Treatment group Type of treatment Duration of treatment	Control group Type of treatment Duration of treatment Total number/ no. of patients completing, *n*/*n*, %	Co-medication allowed Other co-therapies reported side effects	Outcomes usable for meta-analysis Follow-up
Ammer and Melnizky [21] Austria City hospital NR	54 97 w NR	1	NR	Yunus [32] NR	NR	39/30, 76.9	26/19, 73.1	Whirl bath with pine or valerian 36° Min NR 3 × week, 10 times	Whirl bath with plain water of 36° 3 × week, 10 times, Min NR 13/11, 84.6	NR NR NR	Pain VAS 0–100[a] Fatigue NA Sleep NA Depression NA HRQOL NA No
Ardiç *et al.* [22] Turkey University NR	43 100 w NR	2	Other disease	ACR NR	NR	24/21, 87.5	12/12, 100	Thermal pool 37°C 5 × week for 20 min, 3 weeks	No therapy 12/9, 75	Co-medication not allowed NR NR	Pain VAS 0–10[a] Fatigue NP Sleep NP Depression BDI[a] HRQOL FIQ total[a] No
Buskila *et al.* [23] Israel University	54 100 NR	3	NR	ACR NR	NR	48/NR	24/NR	Sulphur pool at 37°C 10 days for 20 min	Therapy as usual 24/NR	Continuation of regular medication NR 2/24 slight flush	Pain VAS 0–10[b] Fatigue VAS 0–10 NP Sleep NA Depression VAS 0–10 NP HRQOL NA Yes
Dönmez *et al.* [24] Turkey University University outpatient department	43 100 w NR	5	Any other condition that might effect study results	ACR NR	NR	28/27, 96.4	16/16, 100	Thermal pool bath 37°C 6 × week for 20 min, 2 weeks	Therapy as usual 14/13, 92.9	Continuation of medication with NSAIDs and antidepressants NR	Pain VAS 0–10[c] Fatigue VAS 0–10[c] Sleep VAS 0–10[c] Depression BDI[c] HRQOL FIQ total[c] Yes
Evcik *et al.* [25] Turkey University NR	42 73 w NR	3	Internal diseases Anti-depressants or other physical treatment	ACR NR	NR	42/NR	22/NR	Thermal pool bath 36°C 5 × week for 20 min, 3 weeks	Therapy as usual 20/NR	NSAIDs NR NR	Pain VAS 0–10[a] Fatigue NP Sleep NP Depression BDI[a] HRQOL FIQ total[a] Yes
Eksioglu *et al.* [26] Turkey University Social security insurance	45 100 w NR	6	Internal diseases Psychiatric disorder Anti-depressant therapy	ACR NR	NR	50/50, 100	25/25, 100	Stanger bath 37°C and amitriptyline 10 mg/day 5 × week for 20 min, 2 weeks	Amitriptyline, 10 mg/day 25/25, 100	No other interventions NR No side effects	Pain VAS 0–10 NP Fatigue NP Sleep NP Depression NP HRQOL FIQ[a] Yes
Fioravanti *et al.* [27] Italy University Rheumatology Divisions	46 98 w NR	5	Internal diseases	ACR NR	NR	80/80, 100	40/40, 100	Usual medication and generalized mud bath 40–45°C followed by immersion in thermal water of 37–38°C 6 × week for 25 min, 2 weeks	Usual medication 40/40, 100	Anti-depressants, tranquilizers, muscle relaxants allowed NR No side effects	Pain VAS 0–100[a] Fatigue NP Sleep NP Depression NP HRQOL FIQ total score[a] Yes
Günther *et al.* [28] Austria University NR	45 100 w NR	2	NR	ACR NR	NR	29/25, 86.2	14/12, 85.7	Hygrogalvanic bath °C NR 2 × week for 20 min, 5 weeks	Jacobson relaxation Four sessions of 3 weeks plus audio casette 15/13, 86.7	No medication NR NR	Pain VAS 0–100[a] Fatigue NA Sleep NA Depressed mood NA HRQOL NA No

(continued)

Table 1. Continued

Reference Country Setting Referral	Mean age, years Women, % Race, %	Methodological quality	Diagnosis of FMS									
			Inclusion criteria		Study population		Treatment group		Control group			
		Van Tulder score	Exclusion criteria	Comorbidities assessed and reported	No. of patients screened/ randomized, %	Total number/ no. of patients completing, *n*/*n*, %	Total number/ no. of patients completing, *n*/*n*, %	Type of treatment Duration of treatment	Type of treatment Duration of treatment Total number/ no. of patients completing, *n*/*n*, %	Co-medication allowed Other co-therapies reported side effects	Outcomes usable for meta-analysis Follow-up
Kurzeja *et al.* [29] Germany Rehabilitation centre NR	50 92 w NR	2	Secondary FMS	ACR NR	NR	66/48, 69.7	28/28, 100	Multicomponent therapy plus mud bath of 40°C and hot air of 42°C 5 × week for 20 min, 3–4 weeks	Multicomponent therapy plus cryocabin, 110°C 5 × week 1–3 min, 3–4 weeks 38/18, 47.4	NSAIDs anti-depressants and analgesic allowed Both groups same multicomponent therapy Control group: 9/20 pain elevation, 5/20 panic attacks and 2/20 skin problems	Pain VAS 0–10[a] Fatigue NA Sleep NA Depressed mood NA HRQOL NA No
Yurtkuran and Celiktas [30] Turkey University NR	37 95 w NR	3	NR	ACR NR	NR	40/NR	20/NR	Thermal pool with 37°C and relaxation exercises 5 × week for 20 min, 2 weeks	Relaxation exercises, intensity NR	No other medical or physical therapy NR No adverse effects	Pain VAS 0–10 Fatigue NA Sleep NA Depression NA HRQOL NA Yes

[a]Used for meta-analysis; means and S.D. included in publication; [b]Used for meta-analysis; means included in publication; S.D. not provided on request, calculated from S.D. of other studies. [c]Used for meta-analysis; means included in publication; S.D. provided on request.
NR: not reported; ACR: American College of Rheumatology [31]; BDI: Beck Depression Inventory; FIQ: Fibromyalgia Impact Questionnaire; NA: not assessed; NP: not provided on request; VAS: visual analogue scale.

publication of the data [20]. Finally 10 studies met our selection criteria and were included for meta-analysis [21–30].

External validity

Some characteristics of the studies and the patients are presented in Table 1. Details are presented in supplementary material 1 (available as supplementary data at *Rheumatology* Online). Side effects or adverse events were explicitely mentioned by four studies: three reported no side effects [26, 27, 30] and one study reported slight flashes in 10% of the patients [23].

Methodological quality

Three studies had a moderate quality (van Tulder score 5–7) [24, 25, 27], and the other ones had had a low quality (van Tulder score <5). Only two studies [24, 25] reported adequate methods of randomization. No study performed an adequate concealment of treatment allocation or an intention-to-treat analysis.

Effects and heterogeneity

The effects of hydrotherapy at the end of therapy and at latest follow-up are shown in supplementary Figs 2–5 (available as supplementary data at *Rheumatology* Online).

There was moderate evidence for a reduction of pain (SMD −0.78; 95% CI −1.42, −0.13; $P < 0.0001$; $I^2 = 83\%$) (nine study arms) and improved HRQOL (SMD −1.67; 95% CI −2.91, −0.43; $P = 0.008$; $I^2 = 90\%$) (four studies) at the end of therapy. The test for overall effect on depressed mood (SMD −0.55; 95% CI −0.55, 0.02; $P = 0.06$; $I^2 = 0\%$) (two studies) was not significant.

There was moderate evidence for a reduction of pain (SMD −1.27; 95% CI −2.15, −0.38; $P = 0.005$; $I^2 = 84\%$) and improved HRQOL (SMD −1.16; 95% CI −1.96, −0.36; $P = 0.005$; $I^2 = 84\%$) (four studies each) at latest follow-up.

Based on Cohen's categories for evaluating the magnitude of effect sizes, the effects of hydrotherapy were large for pain and HRQOL at the end of treatment and at follow-up.

Publication bias

The small number of studies included in the funnel plot limited the meaningful interpretation. The fail-safe-N's calculations indicated that a publication bias was not evident for the data of this meta-analysis (for details see supplementary material 2, available as supplementary data at *Rheumatology* Online).

Subgroup analyses

The comparisons of subgroups showed overlapping CIs of the outcome pain at the end of therapy (details not presented), except the comparison of spa therapy (SMD −1.63; 95% CI −2.31, −0.96; $P < 0.0001$; $I^2 = 73\%$) (five studies) *vs* other types (SMD 0.01; 95% CI −0.45, 0.47; $P = 0.98$; $I^2 = 12$) (two studies). I^2 was >50% for all subgroups except hydrotherapies with a dosage of 200 min with $I^2 = 23\%$.

Sensitivity analyses

The sensitivity analyses did not change the results (for details see supplementary material 3, available as supplementary data at *Rheumatology* Online).

Discussion

The aim of this systematic review was to determine the efficacy of hydrotherapy in FMS. We found moderate evidence for the efficacy of spa therapy in reducing pain at the end of treatment and at follow-up. There is no evidence of the efficacy of medical, Stanger and mud baths. We conclude from the low frequency of

side effects reported and the low drop out rates in the treatment groups that hydrotherapy is a safe treatment option with a high acceptance by the patients. The fact that spa therapy reduced pain in out-patients, who visited spa resorts in their surroundings and continued their normal life, gives support to the hypothesis that the benefits of spa therapy cannot be attributed to a 'holiday effect', but by physical and chemical factors inherent in the thermal water used [33] as well as psychological factors (promotion of psychophysiological well-being).

Our results are in line with a recent systematic qualitative review which concluded that there is moderate evidence for the efficacy of hydrotherapy in FMS [3].

The methodological quality of the RCTs analysed was limited for the following reasons: only three studies had sample sizes of at least 25 per group, which had been identified as appropriate for the detection of clinically important differences between two active treatments [34]. The methodological quality of most trials was low. No study performed an intention-to-treat analysis but analysed the completers. Even if the drop out rates were low, this procedure might have favoured the results of hydrotherapy. Most studies did not report the method of randomization used, all trials did not ensure that the treatment allocation was concealed. Therefore, it is not possible to assess the extent to which selection bias may have occurred in these studies. Furthermore, the studies which allowed co-therapies did not control their effects for dosage or changes in concomitant therapies.

The external validity of the RCTs analysed was limited, because non-Caucasians, patients >65 years and <18 years old and with inflammatory arthritic diseases were not included.

This review has limitations. Some study outcomes, mainly the FIQ subscales, were incompletely reported by most studies and only provided by one author on request. Therefore not all outcomes could be meta-analysed. We found a high heterogeneity and wide CIs of most effect sizes. The small number of trials did not allow to conduct all projected analyses of heterogeneity. Because the meta-analysis included only small trials leading to a large sampling variability, there is a risk to over-estimate the effects of hydrotherapy [35].

In conclusion, spa therapy is a first-line non-pharmacological treatment option of pain in FMS patients living near spa resorts. There is a need for high-quality studies with larger sample sizes to confirm this recommendation.

Rheumatology key messages

- Spa therapy reduces pain and improves HRQOL in patients with fibromyalgia syndrome.
- High quality studies with larger sample sizes are necessary to confirm these results.
- Spa therapy is one first line non-pharmacological treatment option in FMS patients living near spa resorts.

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Supplementary data

Supplementary data are available at *Rheumatology* Online.

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