EFFECTS OF THE HOMEOPATHIC REMEDY ARNICA ON ATTENUATING SYMPTOMS OF EXERCISE-INDUCED MUSCLE SORENESS

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ABSTRACT

Objective: To evaluate the clinical efficacy of Arnica at a high potency (200c), on moderating delayed onset muscle soreness and accompanying symptoms of muscle dysfunction.

Methods: Twenty subjects completed a maximal eccentric exercise protocol with the non-dominate elbow flexors to induce delayed onset muscle soreness. Either Arnica or placebo tablets were administered in a random, double-blinded fashion immediately after exercise and at 24 hours and 72 hours after exercise. Before exercise, immediately post-exercise, and at 24, 48, 72, and 96 hours post-exercise, assessments of delayed onset muscle soreness and muscle function included: 1) muscle soreness and functional impairment; 2) maximum voluntary contraction torque; 3) muscle swelling; and 4) range of motion tests to document spontaneous muscle shortening and muscle shortening ability. Blood samples drawn before exercise and at 24, 48, and 96 hours after exercise were used to measure muscle enzymes as indirect indices of muscle damage.

Results: Regardless of the intervention, the extent of delayed onset muscle soreness and elevations in muscle enzymes were similar on the days following the eccentric exercise protocol. The post-exercise time profiles of decreases in maximum voluntary contraction torque and muscle shortening ability and increases in muscle swelling and spontaneous muscle shortening were similar for each treatment intervention.

Conclusions: The results of this study did not substantiate the clinical efficacy of Arnica at a high potency on moderating delayed onset muscle soreness and accompanying symptoms of muscle dysfunction. Despite the findings of this study, future investigations on the clinical efficacy of homeopathic interventions should consider incorporating research strategies that emphasize differential therapeutics for each patient rather than treating a specific disease or symptom complex, such as DOMS, with a single homeopathic remedy. (*J Chiropr Med* 2005;4:152-161)

Key Indexing Terms: Homeopathy; Arnica; Muscle, Skeletal; Exercise; Delayed Onset Muscle Soreness

INTRODUCTION

Homeopathy is a popular system of medicine practiced worldwide since its founder Samuel Hahnemann, a German physician, first tested the *law of similars* in 1796.¹ A concept tracing back to Hippocrates is that substances capable of producing symptoms in a healthy person could cure similar symptoms in a diseased person if given in small doses, prompting the statement,¹ "let like be cured with like." The most controversial tenant of homeopathic medicine is the principle of the infinitesimal dose where medicines are diluted and succussed (shaken vigorously) repeatedly to make the medicines non-toxic and more potent.^{1,2} The potency of a homeopathic remedy is directly related to the number of dilutions and thereby inversely related to the concentration of the remedy.¹

Arnica montana is listed in homeopathic material medicas from Hahnemann's time to present as the "traumatic remedy par excellence" for fractures, bruises, and muscle strains, because of its analgesic and anti-inflammatory properties.³ Homeopathic practitioners often prescribe Arnica when a patient presents with symptoms of musculoskeletal bruising

and/or aching or sore muscles and the symptoms become worse with touch and/or movement.^{4,5} However, there is a very diverse opinion among homeopathic practitioners about methodologies for prescribing both potency and repetition of homeopathic remedies as well as the selection of the most appropriate homeopathic remedy.^{6,7} This diverse opinion most likely stems from the fact that the treatment approach of well-trained homeopathic practitioners emphasizes differential therapeutics for each patient.⁸ In addition, some homeopathic practitioners use combination remedies, in which a medication contains several homeopathic remedies; thereby, preventing the identification of a specific efficacious agent.⁸

Delayed onset muscle soreness (DOMS) is an extremely common condition experienced by anyone engaging in unaccustomed strenuous physical activity. Exercise models that induce DOMS allow researchers to systematically evaluate neuromuscular dysfunction and therapeutic interventions related to muscle injuries. Muscle dysfunction accompanying DOMS include decreases in maximal voluntary contraction (MVC) force and muscle shortening ability and increases in joint stiffness, muscle swelling and spontaneous muscle shortening.^{9,10} Elevations of enzymatic activities of creatine kinase, lactate dehydrogenase, aspartate aminotransferase, and alanine aminotransferase are indirect, but objective indices of the extent of muscle damage accompanying DOMS.^{9,11,12}

Although the clinical efficacy of Arnica on attenuating DOMS has been studied following bench-stepping exercise and long-distance running (10 km races to marathons), the dosing regimen, combination remedies, small sample sizes, and subjective outcome measures are all factors contributing to the inconclusive evidence regarding the beneficial effects of Arnica.⁸ Arnica was not an efficacious agent for moderating DOMS in any research using a bench stepping protocol.¹³⁻¹⁵ Although the preliminary bench stepping data of Jawara et al¹³ was suggestive of beneficial effect of Arnica in combination with *Rhus toxicodendron* among non-exercisers for attenuating DOMS, their follow-up data did not support the clinical efficacy of the homeopathic remedy, beyond a placebo effect.¹⁵ Pooled results ($n = 82$) demonstrated the beneficial effects of Arnica on reducing muscle soreness from immediate post to 42 hours after marathon running.¹⁶⁻¹⁸ However, other research on long distance running did not substan-

tiate Arnica as an efficacious agent for moderating DOMS.¹⁹

In the studies to date on exercise-induced DOMS, the potency of the homeopathic remedy was a low dosage (eg, 6X, 30X, D30, 30c).⁷ The primary outcome measures were subjective indices of muscle soreness. The exercise protocols involved whole body exercise. The combination of low dosage and extent of muscle damage accompanying whole body exercise may contribute to equivocal results on the beneficial effects of Arnica on moderating DOMS. One previous research study used an isolated eccentric exercise protocol involving the forearm extensor muscles.²⁰ The administration of Arnica in either the sublingual form (6C) or ointment format (4%, 0.5 g dose), every 8 hours for 3 days following the eccentric exercise protocol, did not attenuate DOMS and its accompanying symptoms of muscle dysfunction.²⁰ Other studies reported that Arnica did not attenuate the increases in blood enzymes that are indirect, but objective indices of the extent of muscle damage accompanying DOMS.^{14,16-18}

The purpose of this study was to systematically evaluate the clinical efficacy of Arnica at a high potency, 200c, on moderating DOMS and accompanying symptoms of muscle dysfunction and enzymatic signs indicating the extent of muscle damage. There is some consensus among 300 experienced homeopathic practitioners that an initial potency of 200c (considered a high potency) to begin treatment is an acceptable practice for strong acute symptoms.⁷ A potency of 200c indicates that the process of dilution and succussion (tapping) was performed 200 times on a centesimal scale, which is equivalent to a 100× on a decimal scale. A maximal eccentric exercise protocol, that induces DOMS, is an example of a strong acute case. Laboratory protocols involving maximal eccentric exercise of the non-dominant elbow flexor muscles have been well studied and as such provide a valid experimental model to evaluate the clinical efficacy of Arnica at a high potency, 200c, on moderating DOMS.

METHODS

Participants

The subjects were 20 adult volunteers (32.1 ± 7.17 years; 69.1 ± 14.25 kg; 167.1 ± 7.82 cm). The gender distribution was 10 males and 10 females. The subjects met the following criteria as determined by

an intake questionnaire administered by the principal investigator: 1) no history of musculoskeletal disease or problem; 2) no history of cardiovascular disease; 3) no martial arts or aerobics activities on a regular exercise basis; and 4) no upper extremity exercises such as weightlifting, softball, racquetball, tennis, etc on a regular exercise basis. Regular exercise was defined as 3 or more sessions per week. In addition, the subjects were non-smokers and free of orthopedic abnormalities and neuromuscular impairments of the upper limbs. The standing campus IRB at New York Chiropractic College reviewed and approved all experimental procedures and all subjects signed an informed consent form prior to participation in this study.

Experimental Design

The subjects were randomly assigned to either a homeopathic group (33.0 ± 8.56 years; 64.6 ± 11.19 kg; 166.6 ± 8.71 cm; 6 females and 4 males) or a placebo group (31.1 ± 5.76 years; 73.6 ± 16.07 kg; 167.5 ± 7.24 cm; 4 females and 6 males). The participants randomly drew, without replacement, from the coded packages provided by the pharmacy, Dolisos, at the onset of the testing period. Half of the participants received a homeopathic remedy and the other half received a placebo. The homeopathic remedy was Arnica, 200c potency. The placebo was a neutral lactose/sucrose pellet applied with 87% alcohol and water and dried. The investigators were blinded to the homeopathic remedy or placebo, as the record of the coded packages was kept by the pharmacy. The blinding code was revealed to the investigators at the completion of the statistical analyses.

The subjects committed to the research project for a period of 5 consecutive days. The effects of Arnica on attenuating the symptoms of DOMS were studied during the course of this 5-day experimental protocol. On all test days, the subjects completed a short questionnaire documenting muscle soreness and functional impairments. The subjects also performed a battery of muscle performance tests to document strength, swelling, and range of motion dysfunctions associated with DOMS on all test days. On days 1, 2, 3, and 5, blood samples were drawn from the subject's cubital vein at the elbow by a well-trained medical technologist. Blood samples were used to monitor muscle enzymes known to be elevated with DOMS. On Day 1, the subjects performed 50 maximal eccentric muscle actions with

the biceps muscle of the non-dominant arm. The questionnaire and battery of muscle performance tests were administered pre- and post-exercise on day 1. On day 1, blood samples were only drawn prior to the exercise bout.

The subjects refrained from alcoholic beverages one day before the start of the testing protocol until the completion of testing on day 5. The subjects refrained from taking aspirin, ibuprofen or other anti-inflammatory drugs and from using ancillary treatments (ice, heat, stretching, massage, etc) during the 5-day experimental protocol.

A licensed doctor of chiropractic (DC) also trained and experienced in homeopathy and holding a diplomate of the National Board of Homeopathic Examiners administered either the homeopathic remedy or placebo tablets to the subjects. A 200c initial dose of Arnica or placebo was administered in random, double blinded fashion immediately after the post-exercise testing on Day 1 (ie, at the end of the experimental session). The DC administered subsequent dosages of 200c potency homeopathic remedy or placebo tablets at 24 hours and 72 hours post-exercise (ie, at the completion of each experimental session). The subjects dissolved the 3 doses of either homeopathic remedy or placebo tablets under the tongue.

Eccentric Exercise Protocol

The purpose of the eccentric exercise protocol on day 1 was to induce DOMS. The subjects performed 50 maximal eccentric contractions with the non-dominant elbow flexors using the Biodex System 2 Dynamometer (Biodex Medical Systems, Inc, Shirley, NY). The subjects were seated on a chair with the hips and knees at 90° and the shoulders at 0° of abduction/adduction. The subjects grasped a shaft attachment with their non-dominant hand. The axis of rotation of the shaft attachment to the dynamometer was set to pass through the center of the trochlea and capitulum, bisecting the longitudinal axis of the shaft of the humerus. Each maximal eccentric contraction required the subject to lower the elbow from 60° to 180° in 4 seconds. There were 11 seconds of rest between each eccentric contraction. The subjects performed 25 maximal eccentric contractions in a set and completed 2 sets with a rest period of 5 minutes between the sets.

The velocity setting of the Biodex machine was at 30 degrees/second so as to complete the 120° of

elbow movement in 4 seconds. In the eccentric exercise mode, the powerhead responds to torque input by rotating the shaft in the opposite direction of the imposed load; thereby, lengthening the muscle under tension. Thus, the subject was instructed to provide a maximal flexion torque to which the powerhead responded by lowering the elbow (shaft attachment) at a constant velocity of 30 degrees/sec. The reactive torque output of the dynamometer is the eccentric torque of the elbow flexors. The elbow was re-positioned to 60° by the investigators between each eccentric contraction such that the shaft attachment was passively moved back to 60° of elbow flexion prior to the start of each eccentric contraction.

Measurement Procedures

The timeline for monitoring effects of Arnica versus placebo in the treatment of DOMS was as follows: pre-exercise baseline (day 1); immediate post-exercise (day 1); 24 hours post-exercise (day 2); 48 hours post-exercise (day 3); 72 hours post-exercise (day 4); and 96 hours post-exercise (day 5). Each test session included the measurement of: 1) muscle soreness and functional impairment; 2) MVC torque; 3) muscle swelling; and 4) range of motion tests to document spontaneous muscle shortening and muscle shortening ability.

A 100 mm visual analogue scale (VAS) was used as the measurement of muscle soreness. The subjects provided self-reported degree of soreness rating on the VAS that ranged from 0 mm (no discomfort) to 100 mm (severe discomfort) for the non-dominant biceps muscle. In the standing position, subjects were asked to rate how their non-dominant biceps felt when the examiner lightly palpated the biceps muscle over its entire length with the elbow in extension (DOMS with palpation). The subjects also rated how their non-dominant biceps felt during one repetition of flexing and extending the elbow through its entire range of motion (DOMS with motion). Functional impairment was assessed using a 7-point psychophysical category scale (Fig 1). The subjects selected the category that best described their functional impairment over the past 12–24 hours.

MVC strength of the biceps muscle was measured using the Biodex machine in the isometric test mode. The subjects were seated on a chair with their hips and knees at 90° and their shoulders at 0° of

Category Number	Description
1	A complete absence of soreness
2	A light pain felt only when touched - a vague ache
3	A moderate pain felt only when touched - a slight persistent pain
4	A light pain when moving my arm without carrying something
5	A light pain when carrying or picking up light objects (less than 5 pounds)
6	A moderate amount of pain when carrying or picking up light objects
7	A severe amount of pain that limits my ability to move / use my arm

Figure 1. The 7-point psychophysical category scale for functional impairment used for rating muscle soreness.

abduction/adduction. The subjects grasped a shaft attachment with their non-dominant hand. The axis of rotation of the shaft attachment to the dynamometer was set to pass through the center of the trochlea and capitulum, bisecting the longitudinal axis of the shaft of the humerus. The shaft attachment was locked into position with the elbow at 90° of flexion. In the isometric test mode, the subjects were instructed to pull against the shaft attachment as hard as possible. The MVC trials consisted of a 2-second increase to maximum elbow flexion torque. Maximum torque was maintained for 2 seconds and then the subject was instructed to relax. The subjects performed 3 MVC trials. There were 60 seconds between MVC trials. A fourth trial was included if the peak torques on the first 3 MVC trials differed by more than 5%. Peak MVC torque was measured from the dynamometer output. MVC torque obtained from the voluntary muscle contraction producing the maximal peak torque response was recorded as biceps strength for each test session.

As an index of muscle swelling, a tape measure was used to record arm circumferences with the elbow in extension at the distal location of the biceps muscle. The distal location was 4 cm above the elbow joint. During the pre-exercise test session on day 1, the measurement site was identified with a semi-permanent marker to ensure the consistency of the placement of the tape measure across the test sessions. The measurements were repeated 3–4 times each to ensure the reliability of the measurements. All measurements were taken from the non-dominant exercised arm. The mean of the 3–4 measurements at the distal location was recorded as the index of muscle swelling for each test session.

Range of motion of the elbow joint was assessed by measuring the flexed and relaxed elbow angles using a goniometer. In the standing position and with the elbow hanging down by the subject's side, the relaxed elbow angle (RANG) was measured as an index of spontaneous muscle shortening. In the standing position, the subjects attempted to touch their shoulder with their palm while keeping their elbow at their side. The flexed elbow angle (FANG) was measured as an index of muscle shortening ability. During the pre-exercise test session on day 1, landmark sites were identified with a semi-permanent marker to ensure the consistency of the goniometer placements across the test sessions. All measurements were repeated 3–4 times each to ensure the reliability of the measurements. All measurements were taken from the non-dominant exercised arm. For each test session, the means of the 3–4 measurements for RANG and FANG were recorded as indices of spontaneous muscle shortening and muscle shortening ability, respectively.

In addition to this battery of muscle performance tests, blood samples were used to monitor muscle enzymes known to be elevated with DOMS: creatine kinase (CK), lactate dehydrogenase (LDH), aspartate aminotransferase (ASAT), and alanine aminotransferase (ALAT). On days 1, 2, 3, and 5, blood samples were drawn from the subject's cubital vein at the elbow of the dominant non-exercised arm, by a well-trained medical technologist. On day 1, blood samples were only drawn prior to the exercise bout. Measurements of muscle enzymes on day 1 were used as baseline values. The subsequent measurements during the study at 24 hours, 48 hours, and 96 hours post-exercise were used as outcome measures to document muscle damage. No blood draw was performed on day 4, because peak evaluations in muscle enzymes with DOMS occur at 96 hours post-exercise. Depending on the literature citation, changes in muscle enzyme levels between 72 hours and 96 hours post-exercise are minimal or represent a linear increase from the 48 hours post-exercise. Thus, one less blood draw in the study was deemed acceptable for data collection purposes as well as for subject comfort purposes.

Approximately 9 ml of blood was collected in CORVAC serum separator tubes (Sherwood Medical Company) by venipuncture technique. After allowing 20 minutes for clotting, blood was centrifuged for 10 minutes to obtain serum and then stored at -20°C until analysis. CK, LDH, ASAT, ALAT activi-

ties were measured spectrophotometrically (Cobas Mira) via test kits (Roche).

Data Analyses

The dependent variables are MVC torque, degree of muscle soreness (DOMS with palpation and DOMS with motion), level of functional impairment, muscle swelling, levels of contractile dysfunction (RANG and FANG), and levels of CK, LDH, ASAT, ALAT activities. Degree of muscle soreness and level of functional impairment are indices of DOMS. As such, these dependent variables reflect the effectiveness of the exercise protocol for inducing DOMS. MVC torque, muscle swelling, levels of contractile dysfunction and levels of CK, LDH, ASAT, ALAT activities are indices of muscle dysfunction, injury and inflammation that accompany DOMS.

For all dependent variables, treatment group by test session mixed ANOVA model with repeated measures on test session was used to reveal the effects of Arnica on attenuating the symptoms of DOMS. ANCOVA was used, with the pre-exercise value as the constant covariate, when a dependent variable was different between the treatment groups at the pre-exercise test session. The Bonferroni test was used to control for the experiment-wise error rate. The level of significance for all statistical tests was 0.05. In addition, maximal eccentric torque at the beginning and the end of the exercise protocol was analyzed using a treatment group by time mixed ANOVA model with repeated measures on time. The purpose of this analysis was to document exercise performance.

RESULTS

Muscle Soreness Indices and Functional Impairment

The magnitudes of DOMS with motion, DOMS with palpation, and functional impairment were similar for both treatments (Fig 2). All of the muscle soreness indices were significantly increased on the days following eccentric exercise as compared to the pre-exercise baseline values ($F(5,90) = 20.89_{\text{motion}}; 24.26_{\text{palpation}}; 30.34_{\text{functional impairment}}; p < 0.05$). Muscle soreness indices between 24 and 48 hours post-exercise were significantly greater than values at all other time points ($p < 0.05$). The Wilks Lambda statistic ($F(15, 243.33) = 9.09; s = 3, m = 1/2, n = 43; p < 0.05$), revealed that the multivariate test of significance supported the univariate results for

Figure 2. Muscle soreness levels on 100 mm visual analog scales and functional impairment levels on a 7-point categorical scale. Data from pre-exercise to 96 hours post-exercise for the subjects receiving the homeopathic remedy, *Arnica montana*, and placebo tablets. The error bars represent the standard errors of the means.

DOMS with motion, DOMS with palpation, and functional impairment. These data findings indicate that the eccentric exercise protocol for inducing DOMS was effective.

Muscle Strength and Exercise Performance

Pre-exercise, maximal elbow flexion torques for eccentric and isometric contractions were similar for subjects receiving the different treatments (Fig 3). Maximal eccentric elbow flexion torques were 12.6% greater than isometric MVC torques ($F(1, 18) = 12.35$; $p < 0.05$). Post-exercise decrements to maximum elbow flexion torques for eccentric contractions (37%) and isometric contractions (38%) were similar for both treatments (Fig 3). Post-exercise decrements to maximum elbow flexion torques for eccentric and isometric contractions were unrelated to muscle soreness indices ($r \approx 0.10$) and only moderately related to isometric MVC decrements ($r \approx 0.50$) on the days following the eccentric

Figure 3. Top graph depicts maximal strength for isometric and eccentric contractions, before the exercise protocol. Bottom graph depicts decrements in maximal strength for isometric and eccentric contractions, immediately after the exercise protocol. Data are for the subjects receiving the homeopathic remedy, *Arnica montana*, and placebo tablets. The error bars represent the standard errors of the means.

exercise protocol. Collectively, these data indicate that baseline strength measurements and exercise performance were similar for subjects receiving the different treatments.

Regardless of treatment, there were significant decreases in isometric MVC torques on the days following eccentric exercise as compared to the pre-exercise baseline value ($F(5,90) = 24.54$; $p < 0.05$) as seen in Figure 4. The recovery of isometric MVC torque towards baseline began at 72 hours post-exercise. Isometric MVC torque at 72 hours post-exercise was significantly greater than the immediate post-exercise value ($p < 0.05$). In addition, isometric MVC torque at 96 hours post-exercise was significantly greater than the 24 hours post-exercise value ($p < 0.05$).

Muscle Swelling

Regardless of treatment, increases in the circumference of the distal upper arm as compared to the baseline value occurred at 48, 72, and 96 hours post-exercise ($F(5,90) = 3.74$; $p < 0.05$) as shown in Figure 5.

Muscle Contractile Properties

Exercise-induced changes in the relaxed and flexed arm angles were similar for both treatments (Figure 6). The relaxed arm angle decreased on the days following eccentric exercise ($F(5,90) = 5.02$; $p < 0.05$); whereas, the flexed arm angle increased on

Figure 4. Isometric MVC strength from pre-exercise to 96 hours post-exercise for the subjects receiving the homeopathic remedy, *Arnica montana*, and placebo tablets. The error bars represent the standard errors of the means.

Figure 5. Increases in the circumference of the distal region of the upper arm (4 cm above the elbow the joint) from pre-exercise to 96 hours post-exercise for the subjects receiving the homeopathic remedy, *Arnica montana*, and placebo tablets. The error bars represent the standard errors of the means.

the days following eccentric exercise ($F(5,90) = 11.19$; $p < 0.05$). There was no recovery of the relaxed arm angle after 96 hours post-exercise. The recovery of the flexed arm angle toward baseline began at 48 hours post-exercise, with complete recovery at 96 hours post-exercise. These data indicate that eccentric exercise induced: 1) increases in spontaneous muscle shortening, the relaxed angle at the elbow when subject allows the arm to hang freely by the side; and 2) decreases in muscle shortening ability, the angle at the elbow taken as the subject attempts to fully flex the forearm.

Blood Enzymes

Levels of CK, LDH, ASAT, and ALAT in the blood were all significantly elevated from baseline values at 96 hours post-exercise (Fig 7), regardless of treatment ($F(3,54) = 8.27_{CK}$; 5.24_{LDH} ; 7.16_{ASAT} ; 9.67_{ALAT} ; $p < 0.05$). The Wilks Lambda statistic ($F(12, 135.22) = 3.02$; $s = 3$, $m = 0$, $n = 24 \frac{1}{2}$; $p < 0.05$), revealed that the multivariate test of significance supported the univariate results for each of the blood enzymes.

DISCUSSION

After eccentric exercise, changes in MVC torques, DOMS, muscle swelling, muscle shortening ability and spontaneous muscle shortening followed the expected time course.^{9,10} Elevations in the levels of CK, LDH, ASAT, and ALAT activities on the days

Figure 6. Relaxed elbow angles and flexed elbow angles from pre-exercise to 96 hours post-exercise for the subjects receiving the homeopathic remedy, *Arnica montana*, and placebo tablets. The error bars represent the standard errors of the means.

following the eccentric exercise protocol were consistent with the literature.^{11,12} Most importantly, the results of this research did not substantiate the clinical efficacy of Arnica at a high potency, 200c, on moderating DOMS and accompanying symptoms of muscle dysfunction and enzymatic signs of exercise-induced muscle damage.

Numerous studies have investigated treatment strategies, either preventative or therapeutic, to manage DOMS.²¹ Treatment strategies include cryotherapy, stretching, nonsteroidal anti-inflammatory drugs, oral analgesics, ultrasound, electrical current techniques, massage, compression, hyperbaric oxygen therapy, and exercise.²¹ However, there is limited evidence to support any one particular treatment strategy as efficacious for moderating DOMS.²¹ Although the etiology of exercise-induced muscle damage has been extensively studied, the exact

mechanisms to explain DOMS and accompanying symptoms of muscle dysfunction are still not completely understood.^{10,21} As such, identifying treatment strategies, either preventative or therapeutic, to manage DOMS is still problematic.

The research on the clinical efficacy of Arnica is limited.^{8,22} Rigorous clinical trials do not support the clinical efficacy of Arnica, beyond a placebo effect, for conditions related to tissue trauma.²² The inherent problems to designing clinical trials on homeopathy include inappropriate dosing regimen and combination remedies, as well as, the lack of objective validated outcome measures and small sample sizes.⁸ The major critique of designing clinical trials that treat a specific condition with a single homeopathic remedy and a placebo control, similar to testing of an allopathic drug, is that this experimental design violates the basic treatment approach of homeopathy to treat patients with respect to their whole human being.²²

Even though some very common homeopathic remedies like Arnica are used for simple muscle pain, strain, and overuse syndromes, the major tenet of homeopathy is that each individual's symptom presentation is unique even for a common symptom complaint such as DOMS.^{6,7,23} The individuality of the patient is the final factor in choosing a particular homeopathic intervention.^{6-8,23} In such cases, patient outcomes research, in which the efficacy of the therapeutic intervention and not the efficacy of a specific treatment protocol is assessed, may be the best approach for validating complementary and alternative medicine where the classic placebo-controlled trial may be an inadequate model.^{23,24} The n-of-1 trial can demonstrate causality in a single patient and as such may be an appropriate source of evidence for homeopathy where the individuality of the patient is vital to the selection of the therapeutic intervention and the healing process.^{6,7,23,24} Although the benefits of Arnica in 16 case reports have been questioned for conditions related to tissue trauma,²⁵ the conductance of high quality case reports may still provide the most appropriate evidence underlying the development and understanding of homeopathic knowledge.²⁴

In addition, preference trials and pragmatic trials that incorporate valid and reliable qualitative research methods will allow the diagnosis and treatment to be highly individualized and the assessment of the intervention to involve an in-depth holistic

Figure 7. Muscle enzyme activities from pre-exercise to 96 hours post-exercise for the subjects receiving the homeopathic remedy, *Arnica montana*, and placebo tablets. Blood draws from the dominant arm, ie non-exercised arm. There were no blood draws immediately post-exercise or at 72 hours post-exercise. The error bars represent the standard errors of the means.

approach.^{26,27} As such, these “black-box” experimental designs provide appropriate levels of evidence to evaluate the clinical efficacy of CAM and address the challenges of using the “gold standard” randomized controlled trials to assess complementary therapies.^{26–28} Unless future investigations are successful at developing research strategies to address the holistic nature of homeopathy, the best available evidence, to date, does not support the recommendation of *Arnica* for moderating DOMS and its accompanying symptoms of muscle dysfunction. Our current data indicate that the dosing regimen, ie potency, is not the limiting factor.

While in most cases, DOMS and accompanying symptoms of muscle dysfunction are self-limiting, adverse responses to unaccustomed strenuous physical activity include profound swelling, prolonged losses in MVC force and greatly elevated

serum CK activity.^{9,29} Exertional rhabdomyolysis may occur in a very small percentage of individuals.²⁹ Although adaptations to repeated strenuous exercise occur, the resultant micro-damage during each exercise session may progress to major muscle injuries or at the very least limit athletic performance.^{30,31} To the contrary, adaptations to exercise-induced muscle damage may produce a training effect that increases a muscle’s ability to resist major injuries from subsequent exercise bouts.^{9,31,32} Thus, identifying efficacious methods for moderating DOMS may have implications for treating or preventing muscular injuries, enhancing athletic performance, and/or developing exercise interventions for patients with neuromuscular diseases.^{30–32}

CONCLUSIONS

The results of this research did not substantiate the clinical efficacy of *Arnica* at a high potency, 200c,

on moderating DOMS and accompany symptoms of muscle dysfunction. Despite the findings of this study, future investigations on the clinical efficacy of homeopathic interventions should consider incorporating research strategies that emphasize differential therapeutics for each patient rather than treating a specific disease or symptom complex, such as DOMS, with a single homeopathic remedy. At the current time, clinicians using Arnica indiscriminately for muscle soreness after unaccustomed physical activity should reconsider such practice methods.

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