Cold Air Therapy to cure Peritendopathies and Bursopathies – Initial Clinical Experiences

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Summary

Cryotherapy has meanwhile become an indispensable part of everyday treatment in the field of orthopaedics, rheumatology and sports medicine to cure diseases and injuries of the musculoskeletal system. The latest supplement in cryotherapy is represented by cold air therapy, which simply uses cold air as a therapeutic agent.

On the basis of an uncontrolled therapy study first indications on the efficacy of this method as an accompanying therapy could be gathered from patients diagnosed with tendo- and bursopathies as well as peripheral insertion tendopathies. Over a period of 3 months, 54 patients with different pathological expressions were treated in the 1. Orthopaedic Clinic of the BRK Rheumatology Center in Bad Abbach/Germany. During this period, pain was reduced by almost 90% as shown by the obtained pain score values. No signs of intolerance to therapy were discovered. Cold air therapy proved to be a reasonable additive therapy both with regard to efficacy and cost effectiveness with almost no operating costs involved.

Introduction

As early as in classical antiquity, cold applications in the form of snow, ice and water have been used for therapeutic purposes. In his writings, *Hippocrates of Cos* (460-375 BC) recommends cold drinks to fight fever as well as cold compresses to relieve pain from gout and injured joints. The cold water applications of the German pastor *Kneipp* and his therapy successes are widely known. Meanwhile, cryotherapy (from the Greek *Kryos* = frost) has become an important and indispensable part of treatment not only in the field of orthopaedics, rheumatology and sports medicine but also in physical therapy.

Traditional cold therapy applications such as cold gel packs, cold water baths, cold compresses, and ice cubes have been supplemented and extended over the last 10 years by

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* Dedicated to the 60th birthday of Prof. D. Wessinghage, MD

developing and introducing instrumental methods. In this respect, cold gas therapy, which was introduced by the Japanese physician *Yamauchi* in 1979, marks a milestone in the treatment of rheumatic diseases. Cold gas therapy uses dry liquid nitrogen which is cooled down to -196℃ and applied in gaseous form to the d iseased region. Cold chambers operate in the same manner but allow therapy of the whole body. The latest development is represented by cold air therapy which uses cold air only. Here, cold air is cooled down to –32℃ and blown over the affected body regions.

In a comparative study by Kröling, the efficacy of cold air stream as opposed to ice bag and nitrogen has been proved experimentally. So far, no clinical results have been published. Exemplified by a non-selected patient collective, the presented study evaluates practicability and efficacy of cold air therapy with regard to pain control and patient acceptance. The documented results represent only initial clinical experiences.

Material and Method

From January 1 to April 30, 1992, 54 patients (30 male, 24 female), mean age: 42 years (minimum 30, maximum 52 years), who were having balneo-physical therapy at the 1. Orthopedic Clinic of the BRK Rheumatology Center in Bad Abbach, received an additive cold air therapy using the cryo air method[**]. Depending on the individual disorder and region to be treated, the patients received kinetotherapeutic baths, group gymnastic, therapeutic part or full body massages, electrotherapy, ultrasound. None of the patients received one-to-one sessions of therapeutic gymnastic. Special attention was paid to ensure a time interval of 2 hours between cold air stream application and other therapies. A heterogeneous patient collective was examined with none of the patients suffering from any inflammatory joint disease or acute injury.

Therapy was indicated mainly in patients diagnosed with peritendopathies and bursopathies including insertion tendopathies in different regions of the body after exclusion of other diseases. Mean duration of symptoms was 3.5 years. A graph of the various disorders is shown in Fig. 1. Patients who had frostbites or suffered from arterial circulation disturbance or cryoglobulinemia were not included in the study (with only a few exceptions, this information was not provided to the patients). Prior to the first cold air therapy session, patients filled in a questionnaire which was specifically designed for this study and which inquired about subjective statements, clinical diagnoses and previous treatments. The range

[**] Instrument C 300 by Cadena

of motion was measured using the neutral-0 method. Functional muscle tests were carried out according the method described by *Daniels* and *Worthingham*.

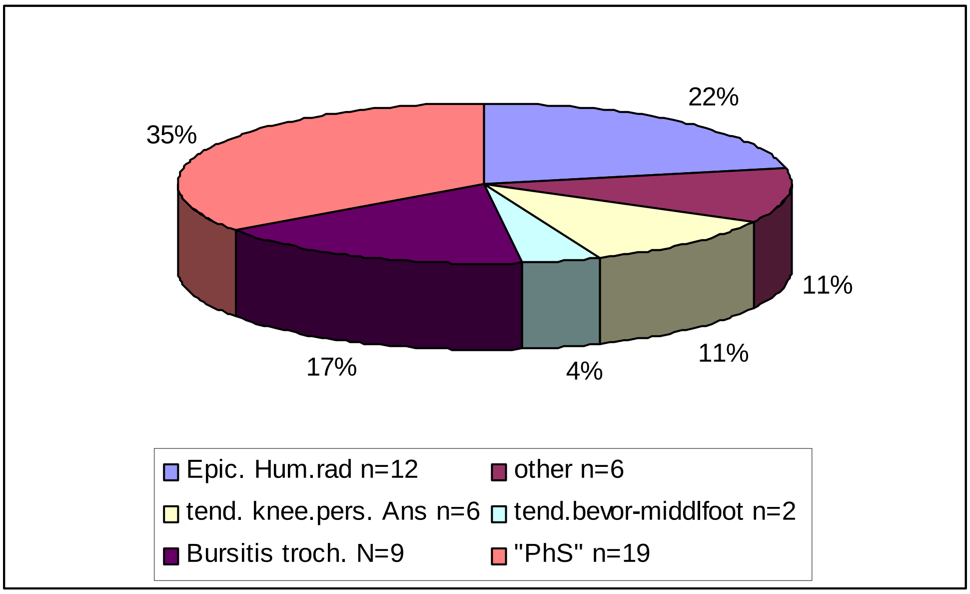

Fig. 1: Ratio of disorders treated with cold air therapy (n= 54)

Both trigger and pain pressure points were palpated. Patients marked their level of pain on *Huskisson's* visual analog scale. Using the visual analog pain scale (VAS) patients describe their current level of pain by putting a mark on a 10-cm horizontal, non-hatched line. Pain intensity is indicated in cm.

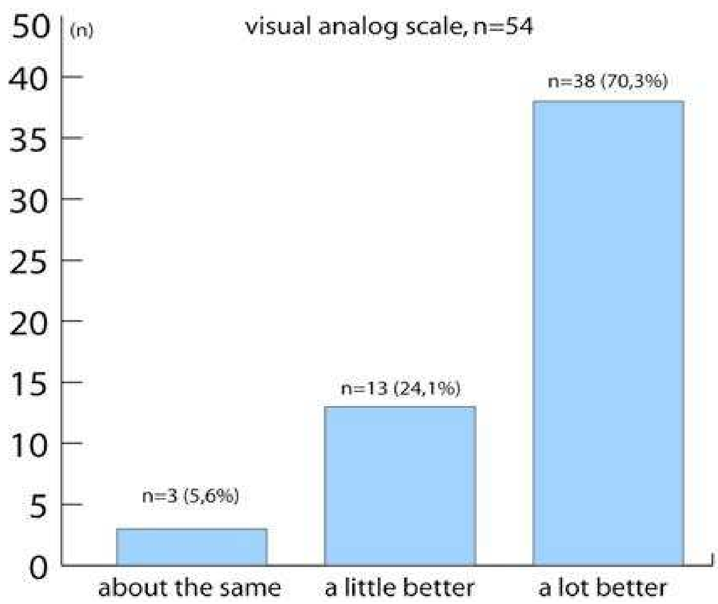

Fig. 2: Cold air therapy: subjective pain improvement after end of therapy: "a lot better" = > 30% improvement on the visual analog scale, "a little better" = 10-30 % improvement on the visual analog scale; "about the same" = < 10% improvement on the visual analog scale

After the end of the therapy session, patients again marked their current pain intensity on the VAS without knowing their initial scores. After each individual treatment, the previously defined trigger or pressure points were palpated and the functional muscle tests, which had been painful before therapy, were carried out to obtain information about the immediate analgesic effect – an effect that is well-known in sports traumatology. In the following therapy session, the duration of pain-free intervals was inquired. Patients who formerly had received cold therapy (though in a different application form) were deliberately included in the study. This applied to 31 (57%) of the 54 patients (ice bags: 26; N_2 -gas: 5). None of the patients had received cold air therapy before. Additionally, patients were asked about their subjective sensation during cold therapy and to classify it according to the categories “comfortable”, “indifferent”, “uncomfortable” or “painful”.

The total number of treatments was 12, with one treatment per day/5 times a week. Treatments were applied over three successive weeks. Therapy was applied for only 1 minute. This was still less than the application time of 2-6 minutes proposed by the manufacturer. Place and time of the treatment were always identical (place of treatment: ward physician’s office, therapist: junior doctor, time: between 8:30 and 9:30 a.m.). No other treatment was administered to the patients before this time. Directly after the treatment, palpation and functional muscle tests were also carried out by the therapist. Cold air therapy was of course only a supplement to the therapy program. The other therapy forms were applied according to the patient’s pathological expressions and regions to be treated; they were – as mentioned above – identical for all patients. This is why the singular effect of cold air therapy cannot be evaluated. As it does not conform to the generally accepted principles of medical treatment, the use of cold as a monotherapy is to be avoided anyway. It should also be noted that there was no control group.

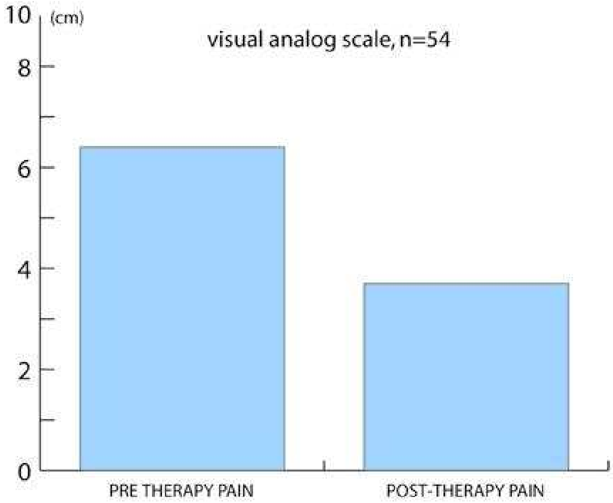

Fig. 3: Cold air therapy: comparison of the pain intensities on the visual analog scale before and after treatment

Results

Of the 54 treated patients, 38 (70.3%) reported a significant pain relief, 13 (24.1%) said pain was a little better, and 3 (5.6%) felt no improvement (Fig. 2). Patients without improvement of symptoms had also received 12 treatments. Analysis of the VAS (0-10 point scale) showed that symptoms improved from a pre-therapy score of 6.4 to 3.7 points after end of therapy (Fig. 3). This corresponds to an improvement of 42.2% of the pre-therapy value. In the post-therapy questionnaire, 33 (61.6%) patients reported pain was a lot better, 17 (31.4%) said pain was a little better, and 4 (7.5%) felt no improvement as compared to the pain sensation before therapy (Fig. 4). “A lot better” refers to an improvement of more than 30% on the visual analog scale, “a little better” corresponds to an improvement of 10-30% and no improvement means less than 10% improvement on the VAS.

Evaluation of the immediate analgesic effect was performed in all patients after the first treatment. These findings conform to the objectifiable results of the study. In 33 patients (61.4%), no pressure pain was detectable in the treated region; when performing the muscle strength tests against resistance patients were free of pain. The mean pain-free interval was 2.5 hours (minimum 30 minutes, maximum 6 hours). The mean pain score was also calculated for the different diagnose groups using the visual analog scale (VAS): the patient group with bursitis trochanterica had a pain score of 2.7; radiohumeral epicondylopathy: 2.6, periarthritis of the shoulder: 2.1; pes anserinus tendopathy: 1.9 points on the pain scale (Fig. 5). Using the neutral-0 method, a limited range of motion was observed in 17 (31.5%) patients prior to therapy. After end of therapy a significant (>20°) improvement of the motion range was observed in 8 patients, little improvement in 8 (10-20°) and no improvement in 1 patient (Fig. 6). At the end of the therapy sessions, the subjective sensation during cold air therapy was described as follows: 48 (88.8%) patients said therapy was comfortable, 3 (5.6%) were indifferent, 2 (3.7%) described it as uncomfortable and 1 (1.9%) said therapy was painful (Fig. 7). No reactions or signs of intolerance to therapy were discovered.

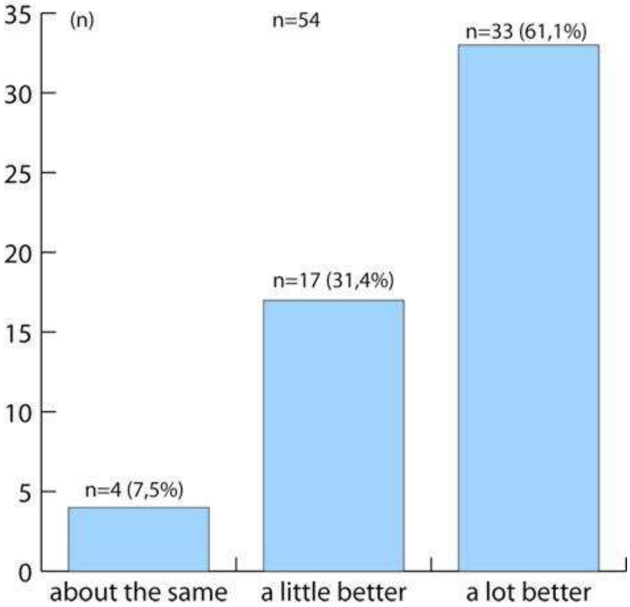

Fig. 4: Cold air therapy: statements on pain intensity after therapy

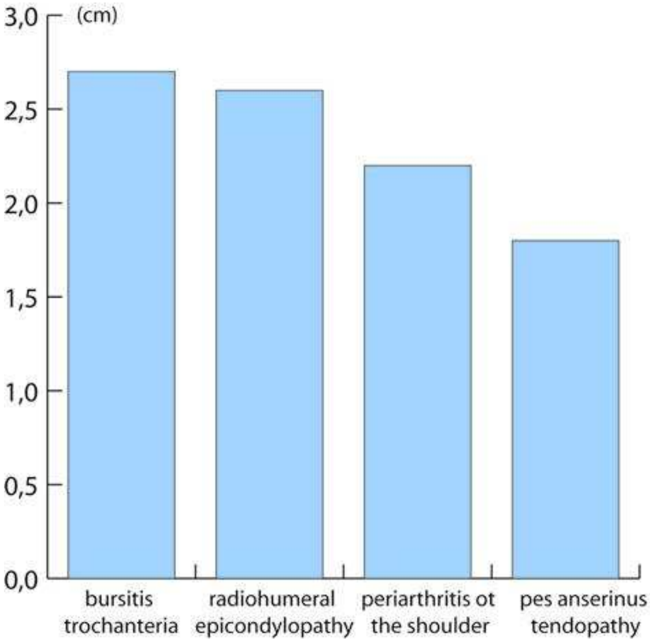

Fig. 5: Cold air therapy: pain improvement. Differences between statements on post- and pre-therapeutic pain intensity on the VAS (improvement by Δ cm).

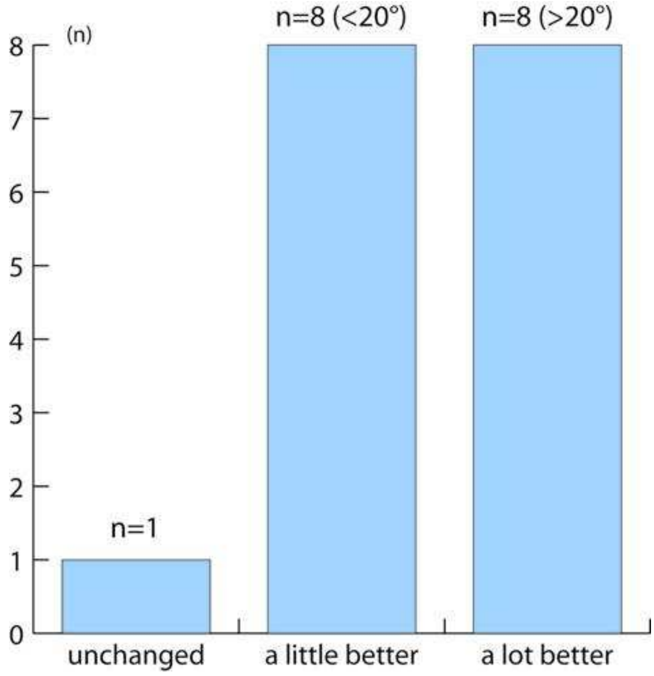

Fig. 6: Cold air therapy: improvement of motion range after therapy. Limited motion range in n = 17 patients.

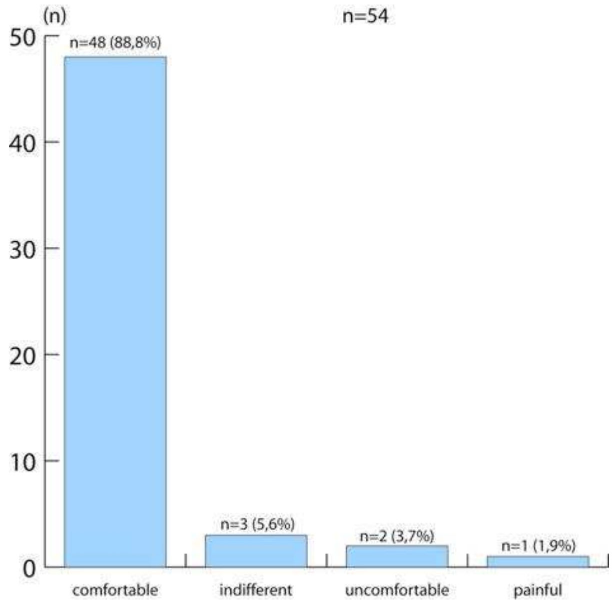

Fig. 7: Cold air therapy: subjective sensation during therapy

Discussion

Cold therapy was on the upswing after introduction of the liquid nitrogen therapy by the Japanese physician *Yamauchi* (1979) who used it to cure rheumatic disorders. Liquid nitrogen therapy, however, with its considerably high operating costs and an application temperature of -196℃, bears the latent risk of different degrees of frostbite. A further development in cryogenic therapy devices was provided by the company Cadena with the introduction of a cold air device that applies dry air with a temperature of -32℃ onto the patient's skin. *Kröling* et al. (1990) demonstrated on the basis of an electrical model in the lateral epicondyle of the humerus that cold applications result in a high significant increase of the pain threshold in joint tissue. The study also showed that cold air stream has an even faster and better effect than liquid nitrogen or cryo gel bag. This was confirmed by our therapy study in which about 60% of the patients reported an immediate and significant relief in pain. Also, tender points localized prior to treatment could no longer be evidenced after therapy. This conforms – in accordance with the experiences made with cold spray and locally applied therapeutic anesthetics in sports traumatology – to the effect of immediate analgesia.

The well-known analgesic effect of various cold applications, which has been proved by numerous authors (*Fricke, Yamauchi, Kröling*), is caused, among other things, by a reduction of the nerve conduction velocity. Actual findings suggest, however, that cold, beyond its direct analgesic effect, may also be efficacious by means of spinal and supra-spinal inhibitory mechanisms. It is assumed that the activation of endorphinergic inhibitory mechanisms plays an important role in this respect. Despite a treatment time of only 1 minute, the observed duration of the therapeutic effect in our patients was on average 2.5 hours and thus persisted significantly longer than the therapeutic effect of 0.5–1 hour which Kröling et al. had reported in their study. As explained above, the length of this interval can certainly not be explained by the local effect, i.e. temperature reduction in the tissue alone. From our point of view, it can rather be interpreted as an indirect evidence of the central-nervous effect caused by spinal and supra-spinal inhibitory mechanisms, as already described by *Kröling* (1990) and other authors. An indirect evidence for this was given by *Kröling* (1991) who detected that the pain threshold after cold application can also significantly be increased on the contralateral side. This phenomenon is common to all forms of cold application.

Altogether, a significant pain reduction was obtained in more than 75% of the patients. In an experimental study, *Kröling* demonstrated the efficacy of cold air therapy by significantly increasing the pain threshold. Cold air stream proved to be the most effective therapy form as compared to cryo gel bag and liquid nitrogen. In our study pain relief was evidenced by improving the pain score on the visual analog scale from a pre-therapy score of 6.4 to 3.7 points after therapy, which is an improvement of 42.2%. Presently, studies on this subject are still missing, which prevents any comparisons to other authors. The fact that cold air, as an intense form of cold application, results in a detonization of the muscles is also crucial for the obtained pain reduction in peripheral insertion tendopathies as these disorders cause a reflex muscle tension. Among other things, a damping of the neuromuscular spindle and gamma motoneuron activity is obtained. Latency and muscle contraction/decontraction time are prolonged under the influence of cold. This effect thus allows interruption of the vicious circle (pain – muscle tension – pain). Analysis of the 31 patients who reported no improvement after previous cold application seems to be particularly interesting. In almost 80% of these patients a significant pain reduction was obtained by means of cold air therapy. Altogether, patients with peritendopathy and bursopathy responded well to cold air therapy.

In an experimental model established by *Knollmann, Berliner* (1990) skin temperature was decreased using cold air stream by 14.9℃ (approx. 45% of the initial value) as compared to the values after cryo gel bag (49%) and liquid nitrogen (41%) application. All three forms of cryotherapy equally decreased the laser Doppler signal of the skin blood flow by approx. 40% of the initial value. The test subjects described liquid nitrogen application as the most comfortable form of cryotherapy (*Knollmann, Berliner* (1990)). Cold air therapy was rated medium. It should be noted, however, that the test persons were healthy individuals and exposed to cold air for a relatively long period (5 minutes). With a treatment time of only 1 minute, 90% of our patients said that the therapy was comfortable due to its pain relieving effect. This phenomenon can also be attributed to the fact that in cold air therapy a dry cold of -32℃ is applied. According to thermo-physical f indings dry cold is easier to bear than damp cold. Cold air results in a drastic heat dissipation with the temperature falling to approx. 2–3℃ within 2 minutes. Cooling performance is redu ced after that due to the high air throughput. Given the further development, however, this proves to be an advantage as the skin temperature approaches the 0°-limit rather slo wly without falling critically below it. This is important both with respect to the patient's subjective sensation and for eliminating the risk of frostbites. Concluding, it can be stated that the cold air application is a reasonable additive to the therapy program. After a session of 12 treatments, each with only 1 minute in duration, pain can significantly be reduced in the majority of patients diagnosed with peritendopathies, bursopathies and insertion tendopathies. Further investigations are necessary, however, to evaluate the long-term effect of the results. Besides extremely short treatment intervals and the possibility to apply the cold air stream to selected regions of the body thus relieving pain, relaxing tensed muscles and improving mobility, the deciding advantage of cold air therapy lies in its economic efficiency. With low operating costs and low power consumption, cold air therapy devices need only ambient air – which comes free of charge. It is mandatory, however, to complete our findings by further clinical studies which use control groups for verification. Actual experiences suggest, though, that cold air therapy is a reasonable supplement to traditional forms of cold application.