

Contrast bathing – a snapshot summary report (Nov 2012)

- **Key messages**

- It has been suggested that contrast therapy causes a “pumping effect” due to a cycle of vasoconstriction and vasodilation, therefore facilitating the removal of oedema. However, controversy exists around this theory.
- Current theory is that constriction of the vessel walls increases intraluminal pressure in the blood vessel; this causes fluid to move with the valves, preventing back flow of fluid and subsequent oedema accumulation.
- Effects of CWI shown in the studies so far include:
 - *Reduced lactate post-exercise*
 - *Improved maintenance of exercise performance.*
 - *Possible effect on cardiovascular function.*
- There is not yet any evidence showing a dose-response from the duration of contrast water immersion.
- Contra-indications include open wounds, poorly controlled epilepsy, infected wounds, hypertension, fear of water and diabetes. If shared facilities are used then those with MRSA should not use them.

Historical background

The therapeutic use of water has a long history dating back to ancient cultures. Water therapies were classified in traditional medicine as:

Hydrotherapy – techniques involving therapeutic bathing and using water;

Balneotherapy – therapeutic bathing in medicinal and thermal springs; and

Thalassotherapy – therapeutic bathing in the sea and using marine products¹.

Hydrotherapy has become the most popular of the water therapies. Hahn, Oertel, Priessnitz, Rausse and Kneipp developed the use of water cures in Europe in the eighteenth and nineteenth century². Hydrotherapy has been advocated using a number of variations including, Kneipp baths, Schlenz baths, Sitz baths and Stanger baths. A variety of disorders were recorded as being treated and aided by such bathing including fibromyalgia³, osteoarthritis⁴, insomnia⁵ and rheumatoid arthritis^{6,7}.

A later development was the galvanic bath, which was introduced by Sere and further developed by Stanger². Galvanic baths were constructed with electrodes and a low voltage direct current (DC) circuit. The electromagnetic field produced was claimed to contribute to improved circulation in the periphery of the body and promoting “detoxification”⁸.

Physical therapies continue to recommend a derivation of water cures, most commonly in the form of “contrast bathing”, using repeated application of, or immersion in, hot/warm water and cold water. Scientific literature now describes this as “contrast water immersion” or “contrast therapy”. In clinical practice, contrast therapy/immersion is recommended to treat symptoms associated with local inflammation and the response to tissue trauma. A more recent use for contrast therapy has been to aid the signs and symptoms of delayed muscle soreness, particularly in athletes⁹.

Physiological mechanism

It has been suggested for some time that contrast therapy produces a cycle of local vasoconstriction and vasodilation resulting in a “pumping effect” to facilitate the removal of oedema by venous and lymphatic removal. Controversy still exists regarding this theory^{10,11}; concern that adequate deep tissue vasoconstriction fails to occur has led to an amendment to the ratio of heat and cold application or immersion used to produce a therapeutic benefit¹¹.

Current theories suggest that oedema is removed because the constriction increases the intraluminal pressure in the blood vessel, causing the fluid to move with the valves in the veins, thereby preventing backflow of the fluid¹². This would produce a beneficial effect of minimising the influence of oedema accumulation while the healing process takes place.

The majority of research in this area has focused on the isolated use of heat or cold and the vascular pumping theory has had little specific investigation and is currently not well supported by evidence. Denegar¹³ suggests that the limited duration of heat and cold application (three minutes and one minute) would be insufficient to effect deep blood flow and to produce a pumping action. Lymph capillaries do not have muscular

walls and would be unable to effect a pumping mechanism, and the intrinsic contraction in blood vessel walls contributes in a limited way to lymphatic flow¹³.

Contrast therapy does, however, produce some therapeutic benefits: Coffey *et al*¹⁴ investigated the use of contrast water immersion (CWI) after exercise and showed that post-exercise lactate was lowered and the subjective perception of recovery improved. Morton¹⁵, in turn, demonstrated that CWI significantly increased the hastening of plasma lactate decrease during recovery after intense anaerobic exercise.

Physiological effects

A growing body of research has been built looking at the physiological effects of contrast therapy. Changes in arterial blood flow in response to contrast therapy have been measured by a number of researchers using a variety of techniques. Fiscus *et al*¹⁶ used strain gauge plethysmography to measure blood flow in the lower limb. This study used four minutes warm water immersion to one minute cold water immersion, over a period of 20 minutes, and produced a significant fluctuation of lower leg blood flow. Decrease in blood flow occurred during the change from warm to cold; increase in blood flow occurred during the change from cold to warm; this effect reduced during successive immersions. A growing number of studies have taken place in the past decade; the variables measured and the physiological effects produced in a small number of recent studies are summarised in the table below.

Study author(s)	Number of participants in study	Physiological process measured	Intervention time ratio (heat to cold)	Total duration of intervention	Effect produced
Myrer <i>et al.</i> (1997) ¹⁷	9 men, 7 women	Subcutaneous and intramuscular muscle temperatures.	1:1 (5 minutes heat and cold repeated twice)	20 minutes	Cutaneous circulation only affected.
Coffey <i>et al.</i> (2004) ¹⁴	14 men	Blood lactate concentration and blood pH.	2:1	15 minutes	Lowers post-exercise lactate.

Fiscus <i>et al.</i> (2005) ¹⁶	24 men	Arterial blood flow in the lower leg.	4:1	20 minutes	Unclear
Morton. (2006) ¹⁵	6 men, 5 women	Blood lactate concentration.	4:1	30 minutes	Hastens reduction of plasma lactate after exercise.
Hamlin MJ. (2007) ¹⁸	20 men	Blood lactate concentration and repeated sprint performance.	3:1	12 minutes	Decreases blood lactate concentration; little effect on subsequent repetitive sprint performance (1 hour later).
Vaile JM et al. (2007) ¹⁹	Athletes: 4 male, 9 female	Creatine kinase concentration, perceived pain, thigh volume, isometric squat strength and weighted jump squat performance.	2:1	15 minutes	Smaller reduction and faster restoration of strength and power measured by isometric force and jump squat performance. Thigh volume was significantly less. No significant difference was found in perceived pain and creatine kinase levels.
French et al. (2008) ²⁰	26 men	Limb girth (mid-thigh and mid-calf), range of motion, lower body power, speed and agility, whole body strength, soreness (using a visual analogue scale) and serum creatine kinase and myoglobin levels	3:1	Not disclosed	Creatine kinase and myoglobin levels were elevated; soreness fell transiently and mid-thigh girth increased - no other significant recovery effects noted.

Crampton <i>et al.</i> (2011) ²¹	16 men split into Wingate cycling group (n=8) And Repeated intermittent sprint cycling group (n=8)	Blood lactate, heart rate and repeated exercise performance.	1:1 (2.5mins) 4:1 (4mins:1 min)	30 mins	Improved maintenance of exercise performance. Likely to be due to the effect on cardiovascular function as a result of alternating hot and cold water immersion.
Stanley <i>et al.</i> (2012) ²²	18 male cyclists	Performance time-trial, heart rate variability measurements, perceptions of recovery.	2:1	10 mins (ending on cold water)	Increased perceptions of recovery. After cold water immersion and contrast water immersion cardiac parasympathetic activity remained above pre-exercise values compared with passive rest for at least 90 mins. No significant effect on subsequent exercise performance.
Higgins <i>et al.</i> (2012) ²³	24 men: Cold water immersion n=8 Contrast bath therapy n=8 Passive recovery n=8	Performance tests, perceived exertion, flexibility, thigh circumference, delayed onset muscle soreness (DOMS) using a visual analogue scale and a pressure algometer.	1:1 (1 min)	10 mins	No positive effects of contrast therapy recorded.

Dose-response

Versey et al²⁴ specifically looked at dose-response in contrast water therapy (CWT). They compared CWT for 6 minutes, 12 minutes and 18 minutes with a seated rest control. They found no dose-response effect from CWT duration on the recovery from high-intensity cycling.

Contraindications and adverse events

Adverse events recorded with this treatment intervention have been notably lacking in the literature. Common exclusion criteria for participants in clinical trials involving CWI include open wounds, poorly controlled epilepsy, infected wounds, hypertension, fear of water and diabetes^{6,25}. In situations where CWI is undertaken using shared facilities known carriers of methicillin resistant *Staphylococcus aureus* (MRSA) are also excluded from participation⁶.

CWI has demonstrated physiological and beneficial therapeutic effects. The mechanism of action requires further research, and the “dose” required in terms of application or immersion time, as with so many other physical therapy interventions, also requires further investigation.

Author: Carol Fawkes, NCOR Research Development Officer

Updated by Elena Ward, NCOR Research Assistant

References

1. http://www.greekmedicine.net/therapies/The_Water_Cure.html.
2. http://en.wikipedia.org/wiki/Spa_bath.
3. Eksioglu E, Yazar D, Bal A *et al*. Effects of Stanger bath therapy on fibromyalgia. *Clinical Rheumatology*. 2007;26(5):691-4.
4. Fransen M, Nairn L, Winstanley J *et al*. Physical activity for osteoarthritic management: a randomised controlled clinical trial evaluating hydrotherapy or tai chi classes. *Arthritis and Rheumatism (Arthritis Care and Research)*. 2007;57(3):407-414.
5. Sung E-J, Tochira Y. Effects of bathing and hot footbath on sleep in Winter. *Journal of Physiological Anthropology and Applied Science*. 2000;19(1):21-27.

6. Eversden L, Maggs F, Nightingale P *et al.* A pragmatic randomised trial of hydrotherapy and land exercises on overall well being and quality of life in rheumatoid arthritis. *BMC Musculoskeletal Disorders*. 2007;8:23.
7. Yeoman W. Hydrotherapy and its place in modern medicine. *Proceedings of the Royal Society of Medicine*. 1950;44:283-285.
8. Duchenne. *De l'ectrisation localisée*, page 8. Paris (1855).
9. Kuligowski LA, Lephart SM, Giannantonio FP *et al.* Effect of whirlpool therapy on the signs and symptoms of delayed-onset muscle soreness. *Journal of Athletic Training*. 1998;33(3):222-228.
10. Knight KL. *Cryotherapy in Sport Injury Management*. Champaign, Ill: Human Kinetics. 1995;3-18,59-71,107-130,175-177,217-232,
11. Prentice WE. *Therapeutic Modalities in Sports Medicine*. Boston: WCB/McGraw-Hill; 1999:187-189.
12. Guyton AC and Hall JE. *Textbook of Medical Physiology*. (10th Ed.), WB Saunders, Philadelphia, (2000).
13. Denegar CR. *Therapeutic modalities for athletic injuries*. Champaign, Ill: Human Kinetics. 2000.
14. Coffey V, Leveritt M, Gill N. Effect of recovery modality on 4-hour repeated treadmill running performance and changes in physiological variables. *Journal of Science and Medicine in Sport*. 2004;7:1-10.
15. Morton RH. Contrast water immersion hastens plasma lactate decrease after intense anaerobic exercise. *Journal of Science and Medicine in Sport*. 2007;10(6):467-470.
16. Fiscus KA, Kaminski TW, Powers ME. Changes in lower-leg blood flow during warm-, cold-, and contrast water therapy. *Archives of Physical Medicine and Rehabilitation*. 2005;86(7):1404-10.
17. Myrer JW, Measom G, Durrant E *et al.* Cold- and hot-pack contrast therapy: subcutaneous and intramuscular temperature change. *Journal of Athletic Training*. 1997;32(3):238-241.
18. Hamlin MJ. The effect of contrast temperature water therapy on repeated sprint performance. *Journal of Science and Medicine in Sport*. 2007;10(6):398-402.
19. Vaile JM, Gill ND, Blazeivitch AJ. The effects of contrast water therapy on symptoms of delayed onset muscle soreness. *Journal of Strength and Conditioning Research*. 2007;21(3):697-702.

20. French DN, Thompson KG, Garland SW *et al.* The effects of contrast bathing and compression therapy on muscular performance. *Journal of Science and Medicine in Sport.* 2008;40(7):1297-1306
21. Crampton D, Donne B, Egana M, Warmington SA. Sprint Cycling Performance Is Maintained with Short-Term Contrast Water Immersion. *Medicine & Science in Sports & Exercise.* 2011;2180-2188.
22. Stanley J, Buchheit M, Peake JM. The effect of post-exercise hydrotherapy on subsequent performance and heart rate variability. *European Journal of Applied Physiology.* 2012;11:951-961.
23. Higgins T, Cameron M, Climstein M. Evaluation of passive recovery, cold water immersion, and contrast baths for recovery, as measured by game performances markers, between two simulated games of rugby union. *Journal of Strength and Conditioning Research.* 2012; Epub ahead of print.
24. Versey N, Halson S, Dawson B. Effect of contrast water therapy duration on recovery of performance: a dose-response study. *European Journal of Applied Physiology.* 2011;111:37-46.
25. Petrofsky J, Lohman E, Lee S *et al.* Effects of contrast baths on skin blood flow on the dorsal and plantar foot in people with type 2 diabetes and age-matched controls. *Physiotherapy Theory and Practice.* 2007;23(4):189-197.