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Title:

Cryotherapy in Sport: A Warm Reception for the Translation of Evidence into Applied Practice.

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Keywords

Injury, Cooling, Research, Musculoskeletal, Pain.

28 **Short Communication:**

29 Precise mechanisms behind cryotherapy applications for acute sport injury
30 management are complex and remain to be fully elucidated due to multiple factors affecting
31 ‘optimal’ application in sporting contexts. Consequently, debate in the literature surrounding
32 the efficacy of cryotherapy for sport injury management is evident and ongoing. Despite the
33 common application of cryotherapy and understanding of the mechanisms underpinning
34 cooling available, confusion still exists in terms of the translation of underpinning mechanisms
35 into optimal protocols advantageous to the athlete in an applied setting. Recently Long and
36 Jutte (2020) raised concerns regarding unverified claims on the negative comments against the
37 use of cryotherapy in sport and health settings for acute soft-tissue injury. In the field of sports
38 medicine and performance, practitioners should be cautious of unverified claims without
39 consideration of best practice; more importantly however, this raises the need for sustained,
40 real-world implementation of translational knowledge into applied settings which is lacking
41 despite many robust and excellent studies available on the topic of cryotherapy application in
42 sport. The successful act of bridging the gap between academia/science (research) and practice
43 is recently acknowledged by Owwoye et al, (2020) highlighting the importance of ‘*theory-*
44 *driven translational research*’ to guide applied and current practices. Although high-quality
45 research in the generalised topic of cryotherapy aim to reduce subsequent scepticism amongst
46 practitioners influenced by weak, unverified or outdated approaches, methodological designs
47 in ‘*discovery research*’ that reflect current applications, encompass multi-measures and
48 acknowledge several mechanisms of cryotherapy should be implemented which will
49 consequently support translation of research findings successfully, whether for or against its
50 use in acute injury management.

51 This leads on to highlight the current perspectives on contemporary cryotherapy
52 applications are evolving and include recently published acronyms such as ‘PEACE & LOVE’
53 (Dubois and Esculier, 2020) (Table 1), whereby the suggestion of removing cryotherapy from
54 acute injury management is presented. Alternatively, Long and Jutte (2020) recommend
55 cryotherapy as part of treatment protocol based on grounded physiological evidence yet refer
56 only to the historical acronym of ‘RICES’ for practitioners to follow in terms of justification
57 for cryotherapy application. As the authors suggest, there is a clear need to clarify 21st century
58 attacks on cryotherapy due to confusion amongst practitioners and therefore it seems pertinent
59 to acknowledge the progressions of ‘RICES’ to ‘PRICE’, ‘POLICE’ and most recently
60 ‘PEACE & LOVE’ acronyms (see full summary in Table 1) to provide a transparent

presentation of contemporary approaches for / against its use in acute injury management. The latter acronym of PEACE & LOVE (table 1) is suggested as a continuum of acute sport injury (PEACE) and rehabilitation (LOVE) management (Dubois and Esculier, 2020), yet not mentioned in the work by Long and Jutte (2020). Interestingly, Long and Jutte (2020) cite a robust evidence base supporting the use of cryotherapy to control the inflammatory process that occurs as a result of soft tissue injury. In contrast, Dubious and Esculier, (2020) suggest that there is no strong evidence base to provision this approach. Importantly, these studies draw opposing conclusions in relation to the efficacy of cryotherapy on inflammatory response, yet consequently the evidence cited in both pieces of work questions the conclusions drawn. The elimination of cryotherapy ('ice') completely from acute sports injury management requires further investigation and contradicts earlier literature supporting the justification of ice within acronyms such as POLICE based on cold-induced analgesia (Bleakley et al, 2012). It is known that cooling has a beneficial effect on the perception of pain through the slowing of neural conductance velocity, with sensory neurons effected ahead of motor neurons contraindications on functional movement are secondary to the reduction of perceived pain (White & Wells, 2013). Hence it is important to note the surrounding benefits of such modality in an applied practice situation for pain management alone following sport injury. Yet, the many acronyms presented in the literature only aid to the confusion in practice and this editorial hope to stimulate the development of new research that rigorously examines such recommendations to provide clarity on understanding and accuracy of credible evidenced-based literature which influences applied practice.

[Table 1 Near Here]

Table 1. Progression and explanation of acronym development which incorporate cryotherapy (in local form 'ice') for acute injury management and accompanying reference for summary.

ACRONYM	EXPLANATION	SUPPORTING REFERENCE
ICE	Ice, Compression and Elevation	Bleakley et al, (2012).
RICE	Rest, Ice, Compression, Elevation	Bleakley et al, (2012).

RICES	Rest, Ice, Compression, Elevation and Stabilisation	Long and Jutte, (2020).
PRICE	Protection, Rest, Ice, Compression and Elevation.	Bleakley et al, (2011).
POLICE	Protection, Optimal Loading, Ice, Compression and Elevation	Bleakley et al, (2012).
PEACE & LOVE	Protection, Elevation, Avoid Anti-Inflammatories, Compression, Education & Load, Optimism, Vascularisation and Exercise.	Dubois and Esculier, (2020).

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90 Discrepancies in the role of cooling for sport injury make it difficult for practitioners to
91 apply optimal applications in sport. Some approaches in studies may inhibit the translational
92 delivery of findings into practice perhaps due to methods not representative of an applied
93 performance nature. Furthermore, several variables, such as dose-response or periodisation of
94 cooling for example which influence optimal sports injury mechanisms still require clarity.
95 Peer-reviewed research reflecting contemporary cryotherapeutic approaches that challenge
96 outdated concepts are important to develop modern-day practices and are required to bridge
97 the gap between academia (research) and applied practice. The consideration of practices only
98 becoming ‘evidenced based’ may relate to methodologies in translational research which truly
99 reflect current applied approaches and, as suggested by Owioye et al, (2020), are executed
100 through context-specific dissemination and implementation study design. Mechanisms behind
101 cryotherapy include physiological, biomechanical, biochemical and psychological wellbeing
102 responses and consequently play a part in optimal applications/protocol designs of such
103 therapeutic modalities and should be investigated in synthesis. Conceptual approaches in
104 cryotherapy research design considering ecological context and best translation of findings to
105 key audiences is supported.

106 Optimal applications of cryotherapeutic modalities in sport are important to ensure
107 maximum physiological benefit for injury and competitive advantage for performance. Holistic,
108 multifactorial approaches to sports injury management and recovery are welcomed, however
109 if sports practitioners are encouraged to base their justification for therapeutic modality use on
110 the best available evidence, then further research to support or refute contemporary approaches
111 are warranted. Long and Jutte (2020) provide a relevant argument in support of cryotherapy,
112 yet alternatively Dubois and Esculier, (2020) provide constructive challenges to historical
113 approaches for the optimal ‘timing’ of cryotherapy for acute sport injury management.

Contention however, between whether the use of cryotherapy ‘does or doesn’t work’ is a simplistic and disputed approach as to its many positive beneficial mechanisms which are advantageous to the athlete. For the development of optimal cryotherapeutic protocols for sport injury, rehabilitation or recovery, methodological design of future studies incorporating biomechanical, biochemical, physiological and psychological mechanisms which reflect current multi-measures of performance and the examination of contemporary modalities with analysis which reflects individual response to interventions may provide more effective transfer of contemporary knowledge into applied practice due to the resemblance of current cryotherapy use in sport.

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Table Captions

Table 1. Progression and explanation of acronym development which incorporate cryotherapy (in local form ‘ice’) for acute injury management and accompanying reference for summary.