The Effect of Cold Spray on Reducing Pain Levels in Acute Sports Injuries: Case Report

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Abstract

Evidence suggests that cold therapy (cold spray) may be recommended with low confidence for reducing swelling in acute soft tissue injuries among athletes. However, the effect of cold therapy on the mechanical function of muscles remains unclear. This study aims to explore the effects of cold therapy application as a treatment strategy to reduce pan in acute sport injuries. Data collection was conducted in April 2024. We present a case of an acute knee injury in a 16-year-old male during a football tournament. He reported pain with a VAS score of 8 (on a scale of 1 to 10). The patient received cold spray as first aid for his knee injury. However, reassessment revealed that the pain level did not decrease. Several factors may influence the effectiveness of cold spray in reducing pain, including the type of affected nerve fibers, duration of the intervention, history of repeated injuries, size of the injured area, and improper spraying technique. Cold spray is effective in reducing pain and inflammation in superficial tissues. However, in acute injuries involving deeper tissues, cold spray does not significantly alter the pain level. Its effectiveness in reducing inflammatory responses in deeper tissues remains uncertain and warrants further investigation.

Keywords: acute pain, cold therapy, foot injury

Introduction

The acronym used in soft tissue injury management has evolved over time, from ICE (ice, compress, elevate), to RICE (rest, ice, compress, elevate), and later to PRICE (protect, rest, ice, compress, elevate) (Alaca & Kablan, 2022). Various cryotherapy modalities have been utilized in clinical settings for acute injuries, including whole-body cryotherapy, cold spray, cryotherapy clamps, frozen peas, cold water immersion, ice, and cold compresses (Costello et al., 2012; Hubbard & Craig, 2004).

According to Edwards et al. (2021), the use of cryotherapy to reduce swelling in acute soft tissue injuries among athletes is supported by low-quality evidence. Cold spray, or vapor coolant spray, is commonly applied in sports medicine, athletic training, and rehabilitation settings. It is fast-acting and typically applied for a shorter duration than other cryotherapy techniques, making it a frequent first-line treatment for sports injuries during training and competition (Enwemeka et al., 2002; Shadgan et al., 2015).

The evaporation of volatile cold-spray liquids from the skin surface induces temporary local anesthesia by desensitizing pain receptors or inactivating ion channels involved in pain transmission (Nadler et al., 2004; Farion et al., 2008). However, research has shown that local cold application may increase resistance to movement (Lakie et al., 1986; Muraoka et al., 2008; Price & Lehmann, 1990), impair muscle flexibility, and potentially raise the risk of further injury (Petrofsky et al., 2013). Despite its widespread use, the effects of cold spray on muscle mechanical properties and its relationship to pain reduction remain poorly understood. Therefore, this case report aims to examine the acute effects of cold spray on pain levels following an acute sports-related injury.

Method

This case report reviews a case of a case of an acute knee injury in a 16-year-old male during a football tournament handled by the public safety centre. Data were collected through prehospital assessments and field observations. Data were analysed based on observations, prehospital interventions, and on-site evaluations. This study aims to explore the effects of cold therapy application as a treatment strategy to reduce pan in acute sport injuries. Data collection was conducted in April 2024.

Case Description

A 16-year-old male sustained a knee injury during a futsal tournament. The day prior to the incident, the patient had also experienced a knee injury caused by a collision with another player. At that time, a cold compress and taping had been applied. During the second match, while chasing an opponent, the patient suddenly fell and complained of pain in his right knee. The pain was intense enough that he requested to be substituted from the game.

Assessment findings: The patient reported a pain score of 8 on the Visual Analog Scale (VAS 1–10). Redness and swelling were observed in the muscle region around the knee, and pulsation was palpable in the affected extremity. The patient winced and complained of increased pain when the leg was moved or lifted.

As first aid, cold spray (*Sport Strain Cooling Muscles*) was applied from a distance of approximately 10 cm to the injured area. A few minutes later, a reassessment was conducted. The patient reported that there was no reduction in pain. Subsequently, the nurse immobilized the knee using an elastic bandage and applied a cold compress.

Discussion

The management of acute muscle injuries commonly follows guidelines such as PRICE (Protect, Rest, Ice, Compress, Elevate) and POLICE (Protection, Optimal Loading, Ice, Compression, Elevation) (Alaca & Kablan, 2022). Although these approaches are effective, they typically require time to achieve a noticeable reduction in pain. In contrast, cryotherapy has been widely used as an immediate, cost-effective intervention to relieve pain and swelling in acute sports injuries. Cryotherapy works by reducing tissue temperature, which in turn decreases inflammation, blood flow, metabolism, tissue edema, muscle temperature, blood pressure, and nerve conduction velocity (Alaca & Kablan, 2022). As a medical treatment utilizing extremely cold temperatures, cryotherapy has several modalities, one of which is cold spray, frequently used as a first-aid option in acute soft tissue injuries.

Cold spray is composed of volatile substances such as ethyl chloride, fluoro hydrocarbons, or alkanes, which rapidly lower skin temperature and produce a temporary local anesthetic effect. This occurs through the desensitization of sensory nerve endings and inhibition of pain transmission. The analgesic effect is rapid but short-lived, typically lasting between 30 seconds and 1 minute (Flynn & Barry, 2016). Proper application involves spraying from a distance of 10–30 cm, at a 90° angle, for no more than 10 seconds to avoid skin damage such as blistering or frostbite (Hijazi et al., 2009; Hotfiel et al., 2018).

In the present case, cold spray was applied as an initial treatment following acute knee trauma in a 16-year-old male. Notably, the patient had sustained a similar injury to the same knee just one day prior. Although cold spray was administered according to recommended distance and technique, the patient reported no decrease in pain level upon reassessment.

This finding is consistent with the study by Barzegar et al. (2021), which reported that cold compresses applied for 10 minutes were more effective in reducing knee pain than cold spray. The extended duration of cold compresses allows them to affect deeper tissues, such as muscle spindles and joint receptors, thereby offering superior pain relief. The difference in effectiveness is likely due to the specific types of nerve fibers involved in pain transmission. Cold exposure slows nerve conduction, especially in small-diameter, myelinated fibers, which are more susceptible to long-duration cooling, as seen in ice compresses, compared to the short exposure provided by cold spray (Barzegar et al., 2021). Consequently, cold spray tends to be more effective for superficial tissues, with limited efficacy for deeper musculoskeletal structures.

Several studies have highlighted the limited analgesic effects of cold spray. Hartstein & Barry (2008) found no significant difference in pain scores between patients treated with cold spray and those who received no such intervention. Similarly, Park et al. (2019) observed that while cold spray could assist in short-term preoperative pain management for ankle fractures, its long-term effectiveness in reducing edema and deep tissue pain was minimal. These findings suggest that cold spray may only be beneficial in specific, short-duration applications.

Another factor influencing outcomes is the inconsistency in cold spray application protocols. Rao et al. (2019) recommended spraying from 5 cm for 5 seconds as effective, while Hijazi et al. (2009) cautioned that spraying at distances below 12 cm increases the risk of tissue damage. The lack of standardized application techniques contributes to variability in outcomes and underscores the need for refined clinical guidelines.

Furthermore, Shadgan et al. (2015) demonstrated that cold spray affects only superficial tissues up to a depth of approximately 10 mm and does not alter the physiology of deeper tissues in healthy adults. In the current case, the patient’s previous injury and the likely involvement of deeper muscular structures may explain the ineffectiveness of cold spray in reducing pain.

In conclusion, the limited effectiveness of cold spray observed in this case may be attributed to several factors, including repeated trauma, the depth of tissue involvement, short duration of cooling, and the localized nature of the application. While cold spray remains a practical tool for managing superficial pain and inflammation, its efficacy in treating deeper or more complex musculoskeletal injuries is limited. Further research is needed to evaluate its clinical utility and to establish standardized protocols for its use.

Conclusions

Cold spray may be effective in reducing pain and inflammation in superficial tissues. However, in cases of acute injury involving deeper structures, it does not produce a significant reduction in pain levels. Its limited effect on deeper tissue inflammation suggests that cold spray alone may not be sufficient as a primary intervention for such injuries. Further studies are required to evaluate its clinical efficacy and to establish appropriate application protocols.

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