The Role of Remote Ischaemic Conditioning in Orthopaedic Surgery: A Narrative Review

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Introduction

Orthopaedic surgery is an important treatment for musculoskeletal (MSK) conditions. In the NHS, 25% of all surgical interventions are for MSK conditions [1] and account for 16.1% of the total cost of surgery [2]. Complications following joint surgery include venous thromboembolism, infection, stroke, myocardial infarction, falls and delirium. [3]

Remote ischaemic conditioning (RIC) is a technique which induces intermittent ischaemia of a limb, through inflating a tourniquet above systolic blood pressure for intervals that avoid physical injury but trigger several intrinsic protective mechanisms (see figure 1). [4] Such mechanisms may induce a resilience to subsequent ischaemia, mitigate excessive inflammatory responses, and improve organ perfusion. [5] Further, there are reports that indicate effects on bone remodelling [6] that may make this a promising treatment in elective and emergency orthopaedic surgeries.

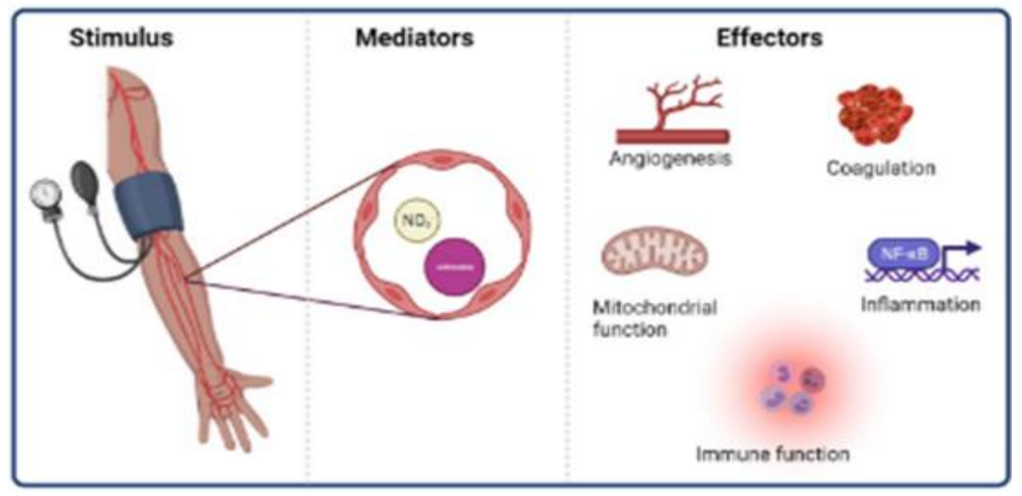

Figure 1. Proposed mechanism of action of remote ischaemic conditioning. *Baig et al 2021* [4]

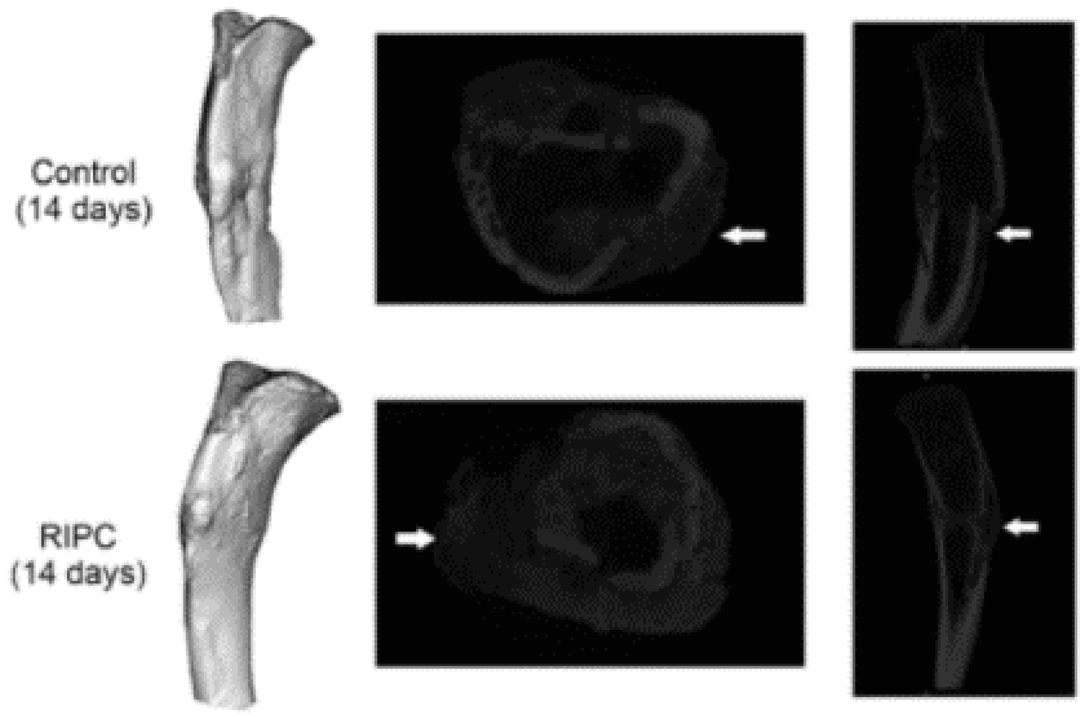

Figure 2. Micro-CT images of fracture healing in rats receiving RIPC vs sham. Arrows indicate callus formation. *Zhou et al 2017* [7]

Methods

A systematic literature search was performed in Pubmed, Medline and Embase for studies investigating RIC in fracture, trauma or orthopaedic surgery, published between 1966 and November 2023. Pre-clinical trials and clinical randomised controlled trials (RCTs) were included. Clinical outcomes from RCTs varied significantly and precluded formal meta-analyses being undertaken, as such a narrative review was performed. PEDro risk of bias scale was performed on RCTs, scores of 9-10 were considered high quality, 6-8 good, 4-5 fair and 0-4 poor.

Results

Three pre-clinical trials studied RIC in animal models. Results showed a reduction in markers of oxidative stress and up-regulation of genes involved in osteoblast expression, causing improved fracture healing (see figure 2). [7]

20 clinical RCT manuscripts considered the use of RIC in elective and emergency orthopaedic surgery, involving 1,276 participants. PEDro scores showed that 17/20 RCTs were of good or high quality. All treatment protocols included one dose of RIC prior to surgery, although the number of cycles varied (range 1-3), as did the occlusion pressure (range 50 mmHg above systolic to 480 mmHg) and limb condition. 17/20 studies demonstrated statistically significant positive outcomes in RIC compared to control, including reductions in markers of oxidative stress (4 out of 6 studies) and inflammation (3 of 7 studies), and increased tissue oxygenation (both of 2 studies). Interestingly, post-operative pain scores were significantly reduced in 4/5 studies measuring this outcome. RIC was also associated with improved muscle strength (1 of 2 studies) and fewer cardiovascular complications at 30 days and 1 year in high-risk individuals following hip fracture surgery.

Discussion

There is evidence that RIC has a positive effect in orthopaedic surgery, however the populations and outcomes measured were varied. Repeated use of RIC, including post-operative doses, may result in more profound beneficial effects. There is a need for designed RCTs to test whether this intervention can improve the clinical outcomes in wider populations.

References

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