

MEDICAL MANAGEMENT OF HAMSTRING INJURIES

FUNKY, FICKLE AND FUTILE?

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INTRODUCTION

The significance of hamstring injuries to the athletes, the complexity of the aetiology, the challenges of diagnostics and the broad principles of management of this common injury are well-established. The question facing this manuscript is whether there is any role for the medical practitioner in expediting the recovery from a hamstring injury. Is the medical practitioner's only role one of diagnosis and assisting in the return to play decision making, or are there methods available to clinicians that may enhance recovery? This is a road infrequently travelled in the medical literature and yet, anecdotally at least, numerous techniques are being used by practitioners – with more or less supportive evidence – to assist in the rehabilitation process. Ideally, any medical

intervention would have a theoretical basis in modifying one or more recognisable phases identified in the repair of muscle injury, specifically:

- minimising degeneration,
- optimising inflammation,
- maximising regeneration or
- negating fibrosis.

Theoretically, it seems reasonable to assume that there must be an optimal balance of each of these processes that would ultimately result in the best muscle repair. The question is (really one of the many available questions), do we have any evidence that (any) medical intervention can either facilitate or accelerate optimal hamstring repair? The purpose of this article is to both highlight some of the interventional methods available and

limitations of those methods for muscle injury management, as they apply to the hamstring.

HAEMATOMA ASPIRATION

Well-recognised in clinical practice, alluded to occasionally in academic manuscripts and commented on in textbooks, the aspiration of a newly-formed or subacute haematoma resulting from a hamstring muscle strain lacks any substantial academic basis. It has long been recognised that the haematoma may be either inter- or intra-muscular, and intuitively, it would be reasonable to surmise that aspiration of the (presumably 'excessive') haematoma will both reduce the body's need to clear it at a later date, reduce the distance across which regenerating



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myotubules would need to bridge, minimise collagen deposition and thereby accelerate the overall healing process. Clinically, however, it is not uncommon for a haematoma to reform following aspiration, and one can only wonder what impact this has on the local healing process, which would already be underway. When this potential disruption is combined with the risk of introducing an infection into what is typically a self-limiting injury, aspiration must remain an available tool for use in exceptional circumstances, rather than common practice.

OPTIMISATION OF INFLAMMATION

Many traditional techniques applied to an acutely-injured hamstring muscle (e.g. ice, rest, immobilisation) are targeted at controlling the extent of inflammation

occurring within the muscle. It is evident that some inflammation is required to ensure that the appropriate mediators of regeneration are available to the healing tissue⁴, but it has long been thought that uncontrolled inflammation is detrimental to healing. Given the relatively superficial understanding we have of the mechanisms of repair in traumatically-injured hamstrings, the optimal degree of inflammatory response remains to be determined. There are, however, a number of interventions that a medical practitioner may consider, in order to support this quest for 'optimal' inflammation.

NSAIDs

Non-steroidal anti-inflammatories (NSAIDs) are often labelled as the bad guys in sports medicine, particularly in soft

tissue management. Simplistically, if one excludes the unproven (but theoretical) risk of increased bleeding when using a non-specific NSAID, by use of a Cox II-type NSAID, the concept of controlling inflammation in the initial post-injury phase using a readily available medicine is appealing. Indeed, at different time points in the history of managing hamstring strain injuries in sports medicine, NSAIDs have been a popular choice². Unfortunately for both practitioners and our patients, numerous animal models have shown suboptimal myofibre regeneration and increased scar tissue deposition associated with NSAID use. While less robust clinical reports in athletes have not shown clear negative effects, in the absence of any recognised benefits over simple analgesia or in clinical trials even placebo, and given the large number of potential systemic side effects, it is difficult to justify any role for NSAIDs³.

Cortisone

The use of intra-muscular cortisone injections for acute hamstring injuries has been recognised for over 50 years². As with NSAIDs, their use is aligned to an underlying assumption that there is the potential to optimise the inflammatory response in an acute muscle injury. Despite the well-described negative impact that cortisone has been shown to have on muscle regeneration, historic case reports, low level clinical series and anecdotal reports suggest that there may be a clinical precedent

and on-going use⁴. Given the potential complications, the known negative impact on muscle regeneration and the self-limiting nature of muscle injuries, neither the balance of evidence nor the WADA Anti-Doping Code supports any role for the use of corticosteroids in muscle injuries.

Traumeel®

Traumeel® is a homeopathic product (oral, topical or injectable) believed to have an anti-inflammatory effect although, according to the manufacturers' information, exactly how it does this remains unclear. Our own personal experience and the observation of many European colleagues suggests that injectable Traumeel® is utilised in many sports medicine settings for acute muscle and specifically hamstring injuries. Internationally, its popularity appears to be regionally determined and with no substantial evidence base for its use, the decision to utilise it would only be on an experiential basis – a significant placebo effect cannot be ruled out.

MAXIMISING MUSCLE REGENERATION

Actovegin® is a deproteinated calf blood haemodiasylate, widely used in a range of areas of medical practice in Europe. Apparently containing a wide range of blood factors including amino acids and trace elements (but no specific growth factors), infiltration of injured muscle with Actovegin® is also believed to enhance muscle regeneration⁵. Injection of acute

hamstring strains with Actovegin® is seemingly so widespread that some authors have even considered it reasonable to use this as a control for even more novel treatments⁶. While limited, at least one clinical trial on the use of Actovegin® in muscle injuries has supported a positive effect on return to play time⁹. A recent report from British users of Actovegin®, with a limited number of subjects and significant methodological limitations, supported a benefit from Actovegin® injection⁵. In addition, WADA have, at times, shown an interest in the potential performance-enhancing effects of (particularly intravenous) Actovegin® and it was recently named in the Australian Football League Club drug controversy. To date, however, it does not appear on the WADA Prohibited List but, given its limited research base, we believe it should remain restricted to experimental or at least audit-based scenarios.

Platelet rich plasma

One of the most topical and reviewed areas in the field of musculoskeletal sports medicine in the early 21st century must surely be the use of platelet rich plasma (PRP) for soft tissue injuries. Typing 'platelet rich plasma' into Google today produces over 1.5 million hits. Adding 'muscle' to that search produces 489,000 hits. Typing the same four words into PubMed highlights 276 academic titles – remarkably, this is despite the continued absence of any well-designed trials assessing its efficacy in



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muscle injury. PRP was first developed in the mid 1990s in the field of maxillofacial surgery. The technique of deriving plasma concentrated in both platelets and growth factors (GF) is now widely used in some fields of medicine, with many potential applications. Today, concentrates of platelets and GF may be prepared simply from the centrifugation of whole blood using a variety of commercially available systems and as a result, at least anecdotally, the use of PRP for hamstring muscle injuries in elite sportsmen and women is widespread and is, by some accounts, increasing. The often overly-simplistic, conceptualised logic applied to explain the manner in which PRP will work in a muscle injury is that GF are required for muscle regeneration and, as PRP contains elevated levels of GF, its administration must, therefore, enhance muscle regeneration. While beautiful in its simplicity, one must remember the complexity of the biochemical milieu into which a (usually unknown) mixture of GF is being randomly distributed. It has

previously been thought that the timing and sequence of activation of specific GF during the regeneration process in muscle is highly sensitive and critical to optimisation of muscle regeneration. This simple statement challenges the appropriateness of bolus doses of autologous PRP injections in muscle healing. Furthermore, it is a fact that the GF in PRP are not present in normal physiological ratios and that they are being placed into the injury site at what equates to a random time point in the healing process, which may of course determine which GF may be beneficial or harmful at that particular time. Surely 1.5 million Google hits, a large number of medical apparatus companies and the high number of very respectable physicians utilising PRP can't be wrong? We don't know, but the use of PRP in hamstring injuries is an area of research into which we and other researchers have invested significant resources. Watch this space in the coming months and years, as we are sure that the answer is out there somewhere.

Hyperbaric oxygen therapy

If the above topics are not left-field enough, the use of hyperbaric oxygen therapy (HBOT) for acute muscle and specifically hamstring injuries is surely controversial to the extreme. HBOT is widely used and has a sound theoretical and evidence base for decompression illness, carbon monoxide poisoning, burns and other superficial wounds. For many years the use of HBOT in muscle injuries has lived on the fringe of sports medicine, with reports of clubs and institutions utilising it for key players, to 'accelerate healing', but limited evidence exists to support its application for muscle injuries. Animal studies on the impact of HBOT on muscle injury have realised mixed results. While it has been shown to inhibit inflammation in injured muscles, it has also been shown to stimulate fibroblast activity and to promote granulation tissue formation, which is contrary to the desired effect⁷. Once again, given the risks involved in utilising HBOT in a self-limiting injury, the jury remains out on whether intensive sessions of HBOT are of any use in accelerating return to play after muscle injury.

MINIMISING SCAR TISSUE FORMATION

While difficult to study, difficult to quantify and as yet clinically unproven, it is generally felt that the replacement of muscle tissue with fibrotic, collagenous scar will reduce the strength of the muscle and increase the likelihood of re-injury. Most of the preceding techniques aim to do exactly that: maximise regenerating tissue while minimising scar tissue formation. Until recently however, there has been no means of directly modifying the deposition of collagen and the formation of scar tissue. Over the last 10 years there has been an increased understanding of the process of collagen deposition and, in particular, the role of the growth factor TGF- β (released by platelets). As a result of this enhanced understanding, numerous agents have been trialled to block its action and to thereby reduce fibrosis. Relaxin, Gamma interferon (γ IFN), Decorin and Suramin have all been shown to reduce fibrosis in injured muscle in animal models. However it is Losartan, an angiotensin II inhibitor commonly used for its anti-hypertensive properties, that

shows the most clinical promise, with trials in mice showing a dose-dependent increase in muscle regeneration and decrease in fibrosis post-laceration⁸. Unfortunately, while encouraging from both a theoretical and basic science perspective, clinical trials assessing the impact on return to play, muscle function, scar deposition and re-injury rate remain to be performed. The challenge in determining the benefit of anti-fibrotic agents in athletes may be delineating an outcome that is easily measurable – fibrosis remains difficult to quantify on imaging and re-injury rate will be multi-factorial in origin.

OTHER CONSIDERATIONS

Over the past 50 years, a variety of enzymatic preparations (e.g. Hyaluronidase, Trypsin, Chymotrypsin) have been touted as being beneficial to the healing of muscle injuries. Unfortunately, there remains no substantial evidence base for their use in hamstring strain injuries. As is clear from the above discussion, there are a range of medical interventions available to the medical practitioner when attempting to enhance hamstring injury repair. Uniformly, it is also clear that the volume of supportive evidence for their use is minimal to non-existent for all of the interventions described.

By contrast, but for obvious reasons lacking clinical evidence, there is animal-based literature to support the use of anabolic agents such as specific isolated growth factors (e.g. IGF-1) and β 2-agonists in the repair of muscle injuries. However, the poor side-effect profile, the multiple-organ impact and the potential for abuse mean that these agents are both contraindicated in muscle injury healing and are prohibited by WADA for use in elite athletes.

Similarly, the use of stem cells of varying origin, or vectors to enhance the delivery of isolated GF or genes may be considerations for the management of muscle injuries in the future, but at the current time remain experimental, contraindicated and of limited benefit in what we must remember is ultimately a self-limiting condition.

CONCLUSION

While contemporary sports medicine literature typically discusses the traditional

and physiotherapy-based modalities in the management of hamstring muscle strains, it is evident that there are a large number of techniques being used by practitioners around the world. These techniques are infrequently discussed in mainstream literature, are most often regionally and temporally popular, invariably have a low level evidence base and are therefore often considered akin to 'snake oil'. It is beneficial to all practitioners in this field to have an understanding of treatment methods available internationally and where, if at all, they may fit into a hamstring muscle strain management programme. It is remarkable that the hamstring has been one of the most significant injuries in sport for over 50 years and yet neither the evidence base for its management, nor its medical management has developed significantly over this period. As we progress through the 21st century, a better understanding of the pathology involved in muscle injuries should ensure a sound theoretical basis for medical interventions aimed at enhancing regeneration. It is important that we maintain an open mind to novel approaches, but more important is that as clinicians and researchers we combine to ensure that we advance our current knowledge base. Let's hope that in the future, medical interventions for hamstring muscle strains are proven to be beneficial to athletes and not to be funky, fickle or futile.

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