REVIEW PAPER

Medicina Sportiva Vol. 5 (EE1): E19-E28, 2001

EVIDENCE BASED CLINICAL PRACTICE IN SPORT AND EXERCISE MEDICINE*

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ABSTRACT

Much of our sports medicine practice has developed empirically and we treat many conditions without knowledge of the quality of the evidence base. If we examine the evidence supporting some aspects of sport and exercise medicine we find major deficiencies. This is in contrast to other medical disciplines with a long history of quality research where clinical practice is supported by a strong literature. If we are to promote sport and exercise medicine as an academic discipline we should be able to support our treatment plans, guidelines, and preventive strategies, with quality research evidence and to measure ourselves against the standard measurement criteria of any academic discipline. Developing an evidence based approach is a key component of our evolution as a clinical discipline.

Key words: systematic, review, appraisal, diagnosis, injury, treatment

The quality of the research literature

A computer based database search offers a proxy indication of the quality of the sport and exercise medicine research literature. It is a crude measurement of quality that has many limitations. A simple Medline search using the key words "injury AND metanalysis" identified 4 articles including two papers addressing ankle sprains, one of which described a Cochrane meta-analysis, an article addressing acromioclavicular dislocation, and an article about knee braces. Using the key words "sport AND systematic review" there were 39 articles of which there were 12 relevant articles. A search of Medline using the key words "sport AND controlled trial" detected 132 articles of which there were 15 articles with an injury focus. Using the key words "injury treatment AND evidence base" there were 120 articles of which 3 were relevant. One feature of this search strategy was how it highlighted the contrast in quality and volume of research between sports science and clinical sports medicine. There was a much stronger research base in scientific aspects of sport than the management of injury or illness.

Clinical examination

Most clinicians use clinical examination techniques without questioning the scientific basis of their development. We learned these techniques in medical school and passed them on to the next generation without questioning their sensitivity and specificity. We believed these techniques to be the best available, but had little means of te-

*Presented at the 3rd International Symposium Medicina Sportiva 2000, Nov. 12-15, 2000, Kraków, Poland

sting their validity. It is now possible to question the validity of these techniques in identifying the clinical finding for which they were designed and apply principles of evidence based medicine to musculoskeletal examination. Many of the accepted tests developed empirically and if a positive test suggested surgery, we could confirm our clinical findings. Thus, the positive predictive value of the test was verified at surgery, but we had no idea of the predictive value of a negative test as these patients rarely came to theatre. Clinicians accepted these clinical signs without question until arthroscopic examination and MRI gave us different tools to help us assess our clinical skills. Using MRI we can now evaluate the accuracy of many clinical examination techniques and demonstrate their sensitivity, specificity, positive and negative predictive value.

Grindell (19) described how, using a battery of tests, including clinical history, apprehension test, relocation test, load and shift test, sulcus sign and crank test, we may improve the quality of examination in shoulder instability (33) and rotator cuff tears (25). VanDijk (58, 59) and colleagues looked at the sensitivity and specificity of physical examination of the ankle. They studied the merits of physical examination in 160 consecutive patients following inversion injury and found the specificity and sensitivity of delayed physical examination for the presence or absence of a lesion of the ankle ligament to be 84% and 96%. Rath and Richmond (46) reported that a true positive McMurray's test was rare even in proven meniscal tears but had almost 100% specificity and that Apley's test was inaccurate.

Evidence supporting clinical practice

Many aspects of clinical practice have evolved empirically without foundation in research. The standard treatment of any soft tissue injury is described by the mnemonic RICE, representing rest, ice, compression, and elevation. There is however, a limited evidence base supporting even this aspect of clinical practice (29). In a systematic literature search using Medline, Embase, SportDiscus and the database of the National Sports Medicine Institute (UK) using the key words ice, injury, sport, exercise, we looked at the evidence underpinning the use of ice in soft tissue injury. There was strong evidence that local application of ice reduces skin temperature, and evidence from animal studies that ice application reduced muscle temperature. But, in most animal studies the duration of ice application would be unacceptable in humans and we identified few appropriate clinical studies. Contrast therapy was ineffective and the nature of the barrier between the ice and skin was critical. We concluded that the optimal method of ice application is melting iced water applied directly to the skin through a wet towel with a target temperature reduction of 10-15°C. There was no evidence from the literature to suggest an optimal frequency or duration of treatment but the consensus from the original research was that repeated applications of 10 minutes are effective. Most studies were undertaken in resting uninjured athletes however and one cannot necessarily extrapolate these findings to athletes who are active or who have had a significant injury. We then undertook a study of the advice given in standard textbooks to see how the original research evidence had been integrated into clinical practice. We found no consensus on the mode of application, duration, or frequency of ice application. As for the other components of the RICE protocol: there is little research published addressing the effectiveness of elevation and the evidence supporting compression is poor (66).

Evidence in injury prevention

Stretching is now accepted as one of the foundation principles in injury prevention. A recent systematic review (54) of all articles related to stretching and injury or pathophysiology of muscle injury questions the evidence that stretching is effective in preventing injury. This study included clinical trials and basic science literature. The author identified four clinical trials where there were positive effects but in three of these warm up was a confounder and in five trials, there was no effect or a negative effect. These findings were supported by the scientific literature and he concluded with five reasons why stretching would be ineffective.

Maintenance of muscle balance should, based on empirical logic, help prevent muscle injury. Many believed that muscle imbalance predisposed to injury and, that early detection with training to overcome imbalance, could aid prevention. Isokinetic muscle dynamometry has now become an integral part of the pre participation examination. We can understand how identifying imbalance, and training to redress imbalance, could become an important component of injury prevention, providing, of course, that we can show that muscle imbalance does predispose to injury. The answer should be found in methodologically sound cohort studies. A recent study of Australian rules footballers (5) does not, however, support this hypothesis. There was no significant difference between injured and non-injured players, and imbalance of 10% between legs or and imbalance of greater than 60% between quadriceps and hamstring strength did not make a difference. Further evidence from well-controlled cohort studies is necessary before we can be certain of our findings but, in this study, isokinetic strength testing was unable to discriminate between injured and non-injured players or predict the likelihood of injury.

Evidence supporting screening

The pre-participation medical examination has become established in sports medicine practice and has generated it's own set of guidelines (10). But, if this examination is undertaken as a screening procedure, then it should meet the recognised criteria for screening (65). There is however, little objective evidence to justify widespread preparticipation screening. In one study (35), from the United States, of 10,540 pre season examinations in athletes aged 10-19 years over a 5 year period, the rate of detection of abnormality was low and most of the abnormal findings were minor. It would be difficult to justify the cost of 10,540 clinical examinations to detect 47 relatively minor abnormalities. Detection rates are universally low and, looking at four other similar studies, comprising 7,358 pre participation examinations in all, the rate of abnormal findings varied between 0.2% to 1.3%.

Sudden cardiac death in sport is the ultimate event. Efforts to prevent these deaths through better screening techniques, improved methods of prevention and better treatment are desirable. When we assess the mortality rates, the prevalence of at- risk conditions, the natural history of disease, and screening methods available, the evidence suggests that screening would be ineffective. One in 10 sudden deaths in young people is associated with sport and in a study (37) of 158 sport related deaths in the young the most common cause of death was Hypertrophic Obstructive Cardiomyopathy (HCM). Of the 158 deaths in this study, however, 115 had had a standard pre participation medical examination. Only four were suspected of having cardiovascular disease and in only one case was the lesion correctly identified.

It is important to ask, from an ethical perspective, if it is reasonable to exclude a young athlete with HCM from participation in sport and, if so, who should make this decision. We do not have sufficient evidence from longitudinal studies that exclusion will change outcome. A recent study (36) of 14 patients with HCM has shown that it is possible to undertake intensive training and 12 of the 14 competed at the elite level. Similarly, the major cause of death during sport for adults is ischaemic heart disease but a review (54) of studies of screening programmes for the disease suggests that they are expensive and ineffective. The exercise stress test is insufficiently sensitive to detect those at risk, and has an unacceptably high false positives rate.

The concept of screening is based on public health principles, and there are recognised guidelines associated with the implementation of any screening programme. Wilson and Jungner (65), in 1968, identified the criteria that should be met before submitting a population to pre symptomatic screening. While these criteria were originally designed for pre symptomatic mass population screening, they are also applicable to sport related screening programmes.

Pre participation cardiac screening would clearly meet some of these criteria. Cardiovascular conditions Hypertrophic Cardiomyopathy (HCM), previously undiagnosed ischaemic heart disease, and Marfans syndrome are clearly important causes of sports related mortality.

The risk of sudden cardiac death in the athletic population is exceptionally small however with estimates of 0.75 and 0.13 deaths per 100,000 men and women per year, which is a risk of 1 per 133,000 men and 1 per 769,000 women (54, 57). Overall, about 1 in 10 sudden deaths in young people are associated with sport. In younger people exercise related death is more likely to be due to a congenital cause, triggered by exercise (50). One exception to this pattern of sudden unexpected death is the series of deaths in Swedish orienteers (63) where the cause appeared to have been myocarditis and where accepted methods of screening would have been ineffective.

To justify screening, there must be an accepted treatment and, in the context of the pre participation medical examination, the intervention is exclusion from sport. One may argue that that this decision should be made by the participant themselves with the availability of the best medical advice (38). In a medical context, we have no evidence that sport reduces overall mortality. It will prevent sudden death in the sporting environment but there is little evidence that it leads to an overall improvement in prognosis.

Thompson's review (54) of studies of screening programmes suggests that they are expensive and ineffective. The exercise stress test is insufficiently sensitive to detect those at risk, and at the same time has an unacceptably high false positives rate. Surprisingly, a high risk strategy is also limited. Tunstall Pedoe (56), who has published extensively on the relationship between exercise and cardiovascular disease in the United Kingdom, has also come out very much against the use of exercise tests.

Management of shoulder injury

Much of current clinical practice in shoulder injury assessment and management evolved from the work of James Cyriax (11) who pioneered the classification of shoulder disorders. He developed his clinical method using meticulous examination and selectively anaesthetising specific anatomical areas in order to define the cause of particular musculoskeletal problems. He classified shoulder pain syndromes, and although widely accepted his classification had not been subjected to scientific scrutiny until recently.

Studies of this classification method have revealed some weaknesses. In particular, studies of inter observer agreement have shown poor reproducibility, with poor agreement on findings between different observers (3, 32, 41, 69). De Winter and colleagues (69) found that, after diagnostic assessment of 201 patients, two trained physiotherapists achieved a Kappa value of 0.45; poor agreement was associated with severe pain, bilateral and persistent complaints. They also found that practitioners were often unable to classify cases into one particular diagnosis. This suggests that perhaps the diagnostic criteria are not mutually exclusive. Three rheumatologists achieved 46 per cent agreement on diagnoses in 26 patients (3) and there was Kappa coefficient of agreement of 0.31 between general practitioners and physiotherapists in the diagnosis of 120 patients (32). Only one study achieved high levels of agreement with 91 per cent agreement and Kappa coefficient of 0.8 in the diagnostic assessment of 21 shoulders in 19 patients (69).

Another approach to diagnostic syndromes is a statistical approach using cluster analysis. This method does not find symptom patterns that conform to our accepted groupings of shoulder disorders. In one study, Winters' group (70) was able to identify three stable clusters. The first cluster was based on severely restricted passive range of glenohumeral movement. In the second group there was no reduction in passive range of movement and in a third group there was with minimally reduced glenohumeral movement. The studies cited above suggest that there are limitations to our current classification system of shoulder disorder and further work is necessary before we can be confident that we have a stable and reproducible classification system and hence reliable information to inform treatment and prognosis.

Clinical examination of the shoulder

A number of accepted tests of shoulder function have been developed empirically without critical evaluation until recently. With increased availability of arthroscopy and MRI scanning we can now determine the relationship between clinical and anatomical or radiographic findings. In particular we can identify the sensitivity and specificity of various tests. Tests for rotator cuff tears, shoulder instability, biceps tendon inflammation and impingement tests have been assessed in surgical patients. Leroux and colleagues (31) evaluated the sensitivity, specificity, and positive and negative predicted values of clinical tests in shoulder impingement syndrome and found that the Neer and Hawkins impingement tests had sensitivity between 87 and 89 percent. The empty can test was found to have a sensitivity of 84 to 86 per cent and a specificity of 58 per cent. Speed's test for the biceps tendon had sensitivity of 63 per cent and specificity of 35 percent. Sensitivity was therefore satisfactory however specificity was poor particularly for determining the location and type of rotator cuff lesions. Functional impairment during manoeuvres did not correlate with the size of Rotator cuff tear. Speer's group (52) assessed the sensitivity and specificity of the shoulder relocation test for instability and found sensitivity of 57 per cent and specificity of 100 per cent. Sensitivity was improved to 68 per cent in the augmented relocation test. Hertel and colleagues (25) evaluated lag signs in the diagnosis of rotator cuff rupture and found the external rotation lag sign to have sensitivity of 70 per cent and specificity of 100 percent for supraspinatus and infraspinatus tendon tears. The internal rotation lag sign had 97 per cent sensitivity and 96 per cent specificity for Subscapularis tears. The lift off test for Subscapularis tears had 62 per cent sensitivity and 100 per cent specificity. Their conclusion was that clinical testing for lag signs was efficient, reproducible and reliable particularly in patients with little or no restriction of movement. Specific tests of shoulder function have therefore been shown to have varying levels of sensitivity and specificity in patients referred for surgical intervention for possible rotator cuff lesions. These assessments of accuracy however cannot be applied to all populations, for instance in primary care.

Management of shoulder dysfunction

A third dimension of evidence based shoulder injury management is the evidence for the effectiveness of current practice. Three recent large systematic reviews have assessed the evidence with regard to the use of non-steroidal anti-inflammatory drugs, physiotherapy, steroid injections, surgery and other treatments, (17, 18, 22) and each commented on the poor methodology of most trials. They concluded that there was little evidence to refute or support the use of most treatments in shoulder pain.

With particular reference to corticosteroid injection, Green and colleagues (18) found evidence, in pooled analysis of study populations, of an improvement in the range of abduction at six weeks with subacromial injections in rotator cuff tendonitis. Subsequent to this analysis van der Windt (67) has shown an improved range of movement and pain with intra-articular Triamcinolone compared with physiotherapy, also at six weeks, in patients with severely restricted range of movement. There is however no evidence in the literature of long-term benefits of steroid injections in shoulder pain. There is also no evidence that some patients benefit more from injections than others or at what stage of shoulder disorders injections are more effective. Well-designed randomised controlled trials are required to assess the effectiveness of shoulder injections in the longer term.

Trials of effectiveness of physiotherapy for shoulder pain have also been criticised on methodological design. A systematic review (23) shows some evidence of the effectiveness of exercise therapy compared with no treatment (16). Similarly there is evidence that laser therapy is effective in comparison with placebo (49) and ultrasound and transcutaneous electrotherapy appear to be ineffective (6, 7, 24, 39). The effectiveness of physiotherapy on long-term outcome has not been adequately assessed. Further well-designed randomised controlled trials are necessary to assess the effectiveness of the various physiotherapy approaches to treating shoulder pain.

The evidence base for assessment and interventions in shoulder pain is expanding, however much work is necessary to develop a strong framework on which to base our management decisions when treating the painful shoulder.

Management of ankle injury

Lateral ankle sprain is one of the most common sports injuries (27) and, in addition to the immediate pain, swelling and loss of mobility, there may be other long term problems such as functional instability and recurrent sprain. For this reason clinicians have explored a number of strategies in prevention. Taping is commonly used but appears to offer little or no mechanical support after vigorous exercise. Indeed, the mechanical restraint of the tape is reduced by 40-50% after only 10-15 minutes (15, 45) which suggests this is unlikely to offer protection against large forces associated with sports. Firer (14) pointed out that there was some evidence that taping was effective in preventing injury but that we were unsure how. Others suggest that the beneficial effects of taping may be due to enhanced proprioception (28, 48) although some (20, 26, 30) believe that reflex contraction of the peroneals will always be too slow to prevent sprains. Modified footwear may help prevent ankle sprains but the evidence is not strong (53) and studies to date have examined high top shoes with claims that the key to preventing ankle sprains is developing more advanced footwear to maximise foot position awareness (47). Other strategies include training programmes such as ankle disk (wobble board) training or injury awareness programmes, which show some positive preliminary evidence (55, 64). Indeed Bahr's intervention programme of injury awareness, technical and ankle disc training halved the number of ankle sprains within two volleyball seasons (2). Orthotic supports have been highlighted in the literature although the quality of methodology in the original research has been questioned (42, 55, 62). Taping, bracing and external orthoses all have their supporters but there is an additional factor that we should consider; the effect on performance (9). In addition, studies of ankle injury prevention are usually within a single sport and findings of such studies may not necessarily be generalisable to other sports. The biomechanical stresses of basketball, for example, may be very different to field hockey and there may also be gender differences, possibly as a result of biomechanical differences. In summary, while there is modest evidence of the effectiveness of some strategies in secondary prevention it is still unclear how we may effectively prevent ankle sprains in athletes with no history of injury.

Diagnosis of ankle injury

Diagnosing ankle injury, based on clinical examination, should be straightforward. The aim is to differentiate between a ligament sprain and complete ligament rupture and there are various radiological aids. Stress x-rays were first used but recent evidence suggests that this is only 50% sensitive in detecting ligament rupture (8, 43). Arthrography is much more effective (44, 60) and Raitticanen (44), in a study of 589 injured ankles, found arthrography to be almost 100 % reliable in diagnosing new anterior talofibular ligament rupture. Immediate clinical examination is complicated by pain and swelling but delayed physical examination has been shown to be equal arthrography (61).

Management of the acute ankle injury

In addition to acute musculoskeletal injury management with ice, compression and elevation (ICE), ultrasound therapy is also commonly used. Van der Windt (68) carried out a systematic review of the effects of ultrasound and found that only four trials met the inclusion criteria, all of which were of modest methodological quality. Three of these studies were placebo-controlled trials showing very small treatment effects of no clinical importance. In spite of theoretical benefit and common usage, evidence of the effectiveness of ultrasound in the treatment of acute ankle sprains is inconclusive. Similarly, laser therapy is also recommended but De Bie et al (12) found, in a randomised double blind controlled trial with a follow up of one year, that both high and low level laser therapy were ineffective in the treatment of lateral ankle sprains. Axelson and Bjerno (1), in a double blind randomised clinical study, also observed no significant difference between patients treated with low level laser therapy or placebo.

Non steroidal anti-inflammatory drugs (NSAID) appear to be effective and, of the 11 randomised controlled studies cited in Medline, all but two provide evidence that early administration of NSAIDS improves both recovery time and symptomatic relief. Ogilive-Harris and Gilbart's systematic review (40) of treatment of soft tissue injuries of the ankle examined 84 studies assessing a wide range of interventions. They considered the studies to be of generally poor methodological quality with lack of consistency in the inclusion criteria and outcome measures and concluded that, other than non-steroidal anti inflammatory drugs and early mobilisation, it was difficult to make firm recommendations on optimum treatment.

Some good news

It would be unfair to focus only on the limitations of our knowledge in sports medicine practice for there is evidence, from high quality randomised controlled trials that some therapeutic interventions are effective. Corticosteroid injection is effective in tennis elbow (21), and is effective in the painful shoulder problems (18), as is physiotherapy (23). Conservative management is best of acromioclavicular dislocations (4) and there is evidence that having a physiotherapist or doctor present can reduce injury in soccer (13). These are just some of the studies identified in a search for randomised controlled trials, but they illustrate the importance of identifying quality evidence to support practice.

Conclusion

We have come a long way in the evolution from clinical interest group to a recognised clinical discipline, but the establishment of a clinical method, supported by developments in education, appears to have moved faster than efforts to create a quality research culture. Establishing medical Royal Colleges, achieving specialist registration, and integrating sport and exercise medicine clinics into the traditional hospital environment give the appearance of a strong and vibrant specialty. We cannot be quite so confident when asked to justify, from research evidence in peer reviewed literature, the principles of clinical practice. Our literature reflects the foundations upon which our future will be secured. We need to develop quality research, so that we can justify what we do on a more scientific basis, not just citing clinical experience. So for every enthusiast who suggests a new clinical test, a new treatment or means of prevention, ask them for the evidence, and remember that the plural of anecdote is not data (34). The future success of sports medicine demands that we provide science to underpin clinical practice.

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Received: March 16, 2001
Accepted: April 20, 2001

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