

# OVERDIAGNOSIS IN SPORTS MEDICINE

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## BACKGROUND

Overdiagnosis is defined as the identification of an ‘abnormality’ that will never cause symptoms or death during an individual’s lifetime<sup>1</sup>. Overdiagnosis can be a side effect of screening for early forms of disease, but it is also observed in establishing a diagnosis after injury or evaluation of a recovery process after injury. Screening or measurements of diagnosis or recovery can be helpful in many cases, but may also have limitations and result in disadvantages for the individual being tested. Overdiagnosis occurs when an abnormality or disease is diagnosed correctly, but the abnormality or established diagnosis is irrelevant. This may result in harm for the tested individual if:

- It causes concern when treatment is not possible,
- Potentially harmful diagnostics are needed to establish a diagnosis or
- It causes unnecessary uncertainty about the treatment progress.

## Breast cancer screening

Breast cancer screening is an example in general medicine where overdiagnosis is present. There is clearly a reduction of mortality rates as a result of routine screening of the general population using mammography<sup>2</sup>. One of the main concerns of these national screening programmes is the manifestation of overdiagnosis. This means that certain breast cancers are detected with mammography that will not become clinically apparent during a patient’s lifetime. The major reasons for this are detection of slowly growing tumours that will never become malignant and competition with other causes of mortality, which is especially significant in the elderly. Overdiagnosis is present in approximately 11 to 22% of the breast cancer screening programmes, meaning that approximately 1 out of 5 to 1 out of 10 detected breast cancers are clinically irrelevant<sup>2</sup>. This downside of screening

causes a lot of unnecessary concerns, additional follow-up investigations and may also lead to overtreatment. For this reason, some advocate to properly inform screening invitees about the possibility of overdiagnosis before deciding participation in the programme. The *British Medical Journal* and *Journal of the American Medical Association* create awareness of this problem through their ‘Too Much Medicine’ and ‘Less Is More’ campaigns. Accordingly, even in screening programmes that have proven efficacy on mortality rates, there are serious concerns about the effects of overdiagnosis.

## Background of overdiagnosis in sports medicine

Sports medicine is a field where patients or athletes have high expectations and demands from their healthcare providers. The sports medicine physician has a key role in the multidisciplinary team for

health management of the athlete<sup>3</sup>. Sports medicine for elite athletes is challenging on many fronts and there is frequently an expectation of easily accessible imaging or innovative investigations aiming to improve athlete health and performance. Sports medicine has seen significant technological progress in recent decades and by any measure has delivered substantial value to individual athletes. It is of crucial importance to estimate the exact value of these measurements for the athlete's health. Within this context, sports physicians are faced with the possibility of overdiagnosis in sports medicine.

The aim of this article is to describe examples of overdiagnosis in the field of sports medicine. It is important to know what is not regarded as overdiagnosis and what definitely is considered overdiagnosis. Recommendations will be provided on how healthcare professionals in sports medicine can prevent overdiagnosis. This aids the sports physician and affiliated organisations in reconsidering the impact of clinical decision-making in the athlete's healthcare.

#### WHAT IS NOT OVERDIAGNOSIS IN SPORTS MEDICINE?

Diagnostics are the start of clinical reasoning and medical management. The foundation of diagnostics are both adequate history taking and physical examination which result in a working diagnosis. Additional diagnostics may be needed to confirm or reject a working diagnosis. Two examples in team care situations can be given:

As a team physician who suspects an ankle fracture in an athlete on the field, based on the Ottawa ankle rules<sup>4</sup>, an X-ray would be needed to rule out an ankle fracture. In this example, there is clearly no overdiagnosis as the X-ray has the potential to diagnose a fracture and will therefore affect management and treatment outcome. The question is whether this would change

when a team physician faces a similar situation (a painful ankle after trauma) but with negative Ottawa ankle rules. If the sports physician still requests an additional X-ray to rule out an ankle fracture, would this meet the criteria of overdiagnosis? One can consider that there are both costs and a tiny amount of radiation needed for an ankle X-ray. The dose of radiation can be considered negligible, so we can conclude that it does not result in harm for the tested athlete. It would not cause concerns – the additional diagnostics would remove potential uncertainty in this case. Furthermore, the outcome of the X-ray has additional value to the diagnosis and prognosis. Consequently, there seems to be absence of overdiagnosis in this second example. However, it should be noted that from a healthcare economical point of view this approach is worse. Additionally, another problem that may arise is the presence of a coincidental finding on X-ray. For example, the finding of an asymptomatic bone cyst or radiologic osteoarthritis can lead to more additional investigations and cause unnecessary concerns for the athlete. In these cases, overdiagnosis is around the corner. So additional investigations should always be used appropriately, not only from an economical perspective.

#### WHAT IS OVERDIAGNOSIS IN SPORTS MEDICINE?

There are a number of examples in the field of sports medicine where overdiagnosis is overt. In the section below, two examples will be described; one in the pre-participation screening setting and one in the recovery of musculoskeletal injuries.

##### *Athlete screening*

One clear example where overdiagnosis is present in sports medicine is in screening programmes for athletes. To ensure that screening programmes confer the benefits intended, the WHO published the Wilson-Jungner criteria for appraising a screening programme (Table 1)<sup>5</sup>.

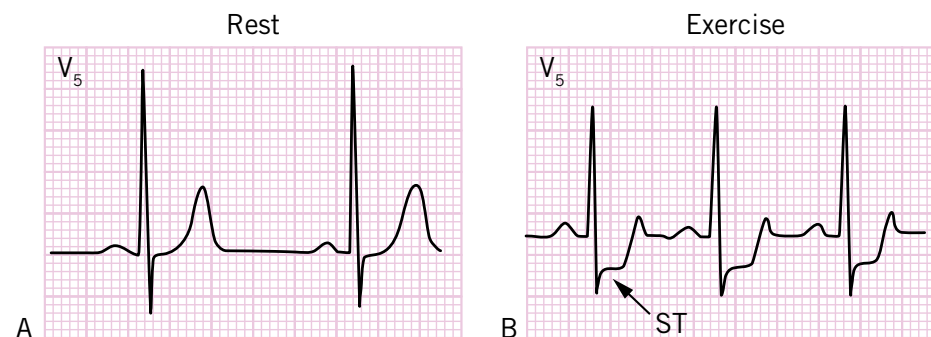
It is interesting to bear these criteria in mind when evaluating the role of pre-participation exercise testing in athletes. Cardiovascular disease is the leading cause of death in many countries and it therefore is an important health problem. For some sports federations or organisations of major sports events, the exercise electrocardiogram is a compulsory part of a medical screening examination. The major aim of these tests is to exclude presence of coronary heart disease, which can be detected with exercise-induced ST depression on electrocardiography.

**TABLE 1**

1.	<i>The condition should be an important health problem.</i>
2.	<i>There should be a treatment for the condition.</i>
3.	<i>Facilities for diagnosis and treatment should be available.</i>
4.	<i>There should be a latent stage of the disease.</i>
5.	<i>There should be a test or examination for the condition.</i>
6.	<i>The test should be acceptable to the population.</i>
7.	<i>The natural history of the disease should be adequately understood.</i>
8.	<i>There should be an agreed policy on whom to treat.</i>
9.	<i>The total cost of finding a case should be economically balanced in relation to medical expenditure as a whole.</i>
10.	<i>Case-finding should be a continuous process, not just a 'once and for all' project.</i>

**Table 1:** Criteria for appraising a screening programme.

An abnormal test finding can result in an invasive coronary angiography and (surgical) treatment if indicated. A well-known problem with exercise testing is the occurrence of false-positive and false-negative results. A systematic review showed a mean sensitivity of 68% and mean specificity of 77% for exercise-induced ST depression and this was even tested in symptomatic populations<sup>6</sup>. Given the low likelihood of cardiovascular disease in asymptomatic athletes, both the positive and negative predictive value of this test characteristic are disappointing. Consequently, a large number of individuals will have unnecessary concerns due to a positive test result but no actual coronary abnormality. There is also a group that will be reassured while a coronary abnormality is present. These statistics are even worse in the athletic population. In a Dutch study, 1298 athletes had exercise testing of which 4% had an abnormal test result. Only 5% of these athletes who initially tested positive had a true positive test result, so there is a large number of false-positive test results in this population<sup>7</sup>. Aren't these athletes at a higher risk? Large long-term follow-up studies indeed show an increased mortality risk with an abnormal exercise test compared to a normal test<sup>8,9</sup>. In conclusion, an abnormal exercise test result causes concerns that may be reasonable on the longer term, but there are no treatment



**Figure 1:** ECG at rest (a) and during exercise (b). Note the ST-segment depression that can be observed during exercise (arrow). If exercise testing is used to detect cardiovascular abnormalities, it may cause concerns while there are no treatment options available. This is a clear example of overdiagnosis in sports medicine.

options available in case of false-positive testing. This makes exercise testing, in asymptomatic athletes, with the aim to detect coronary artery disease a good example of overdiagnosis.

#### *Imaging after rehabilitation of musculoskeletal injuries*

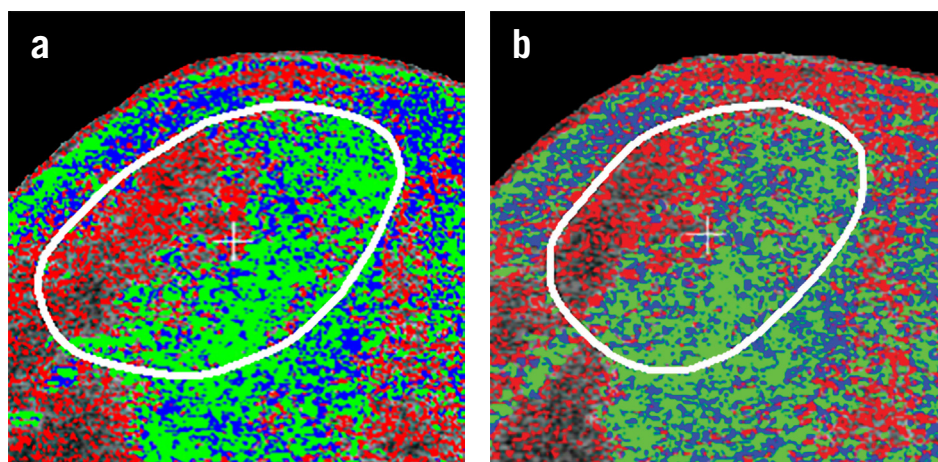
Musculoskeletal injuries are frequently diagnosed using additional imaging in daily clinical practice. Examples are; acute hamstring injuries that are commonly evaluated with Magnetic Resonance Imaging (MRI) and tendinopathies that are frequently confirmed with the use of ultrasound modalities. There is a parallel with the example of acute ankle trauma as described above. The imaging can help the patient as confirmation of the diagnosis

and in case of the acute hamstring injury it also might have some prognostic value as there is moderate evidence of a shorter time to return to play (RTP) in MRI-negative injuries<sup>10</sup>. Also for these examples, it is clear that there is a low likelihood of overdiagnosis.

#### *MRI in recovery of hamstring injuries*

Imaging is also used as a measure of recovery in athletes who have successfully completed a rehabilitation programme after a musculoskeletal injury. The use of MRI in athletes who have clinically recovered from an acute hamstring injury is a good example. In elite athletes in particular, it is not uncommon to use additional investigation in an attempt to provide a more complete overview of the rehabilitation process

**Prevention of overdiagnosis is important, as once athletes are labelled with a diagnosis there will be medical, social, emotional and economic consequences**



**Figure 2:** Axial images of ultrasound tissue characterisation in a patient with chronic Achilles tendinopathy before the start of treatment (a) and during follow-up (b). There is a large clinical improvement, but no major ultrasonographical change. It is unclear how this would influence management and the current evidence tells us that this should be regarded as overdiagnosis.

and assist in avoiding a re-injury. This last reason is at least questionable. Studies have shown that the majority of the recovered hamstrings still exhibit intramuscular oedema on MRI<sup>11,12</sup> and that this oedema is not associated with re-injury<sup>13</sup>. Furthermore, there is no association between re-injury and the presence of intramuscular fibrosis measured with MRI at RTP<sup>14</sup>. Consequently, there is currently no strong evidence for an association between MRI parameters at RTP and hamstring re-injury. It will therefore not help the clinician and athlete to estimate the re-injury risk and there is a high chance of finding imaging abnormalities. These findings can certainly result in a prolonged time to RTP in many cases, while there is no evidence that this will result in decreased risk of re-injury. In these cases, performing the MRI causes disadvantage to the athlete and thus overdiagnosis is present.

#### *Ultrasound in the management of Achilles tendinopathy*

The use of imaging during the recovery of Achilles tendinopathy is another example where overdiagnosis is present. Using standardised ultrasound (ultrasound tissue characterisation) it is possible to objectively follow the change of tendon structure over time. However, the first studies with a prototype of standardised ultrasound showed no correlation between change in tendon structure and change in symptoms over time<sup>15,16</sup>. Studies with new machine settings are currently being performed, but the existing evidence from the prospective cohort studies show that it is impossible to predict symptomatic recovery of the patient based on the imaging parameters. What should be advised for the patient with good

stepwise clinical progression and worsening on imaging? If one would recommend slowing down the intensity of the rehabilitation – for which there is currently no evidence – there might be a disadvantage for the athlete, as rehabilitation will be prolonged. If no slowing of the rehab would be undertaken, it is very questionable why imaging should be performed. Hopefully future studies will change the knowledge on this subject, enabling subgrouping based on imaging parameters. At the present time the current evidence tells us that this should be regarded as overdiagnosis.

#### RECOMMENDATIONS TO PREVENT OVERDIAGNOSIS

Prevention of overdiagnosis is important, as once athletes are labelled with a diagnosis there will be medical, social, emotional and economic consequences – which can be permanent in some cases. It is essential to move away from a ‘more is better’ culture, despite pressure from the athlete, coach and club, biased reporting in medical journals and commercial conflicts of interest<sup>17</sup>. The main question is how to deal with overdiagnosis in sports medicine?

##### *Athlete screening*

In the athlete screening example, the sports physician could provide asymptomatic athletes with information that increase their understanding about potential harms of exercise testing with ECG<sup>18</sup>. An athlete who undergoes exercise testing with the aim to have more data about the cardiovascular health status, should be informed about the limitations and impact of a positive test result. This creates awareness of the test limitations

and offers athletes a choice. This awareness should not only reach the athletes, but also the sports federations and organisers of sports events that oblige exercise testing as part of the pre-participation examination in asymptomatic athletes.

A drawback of this approach is that in reality, biased information is provided with an emphasis on the benefits and not on the potential risks of harm from positive results. Another problem is the ethical discussion that some athletes are not given a choice whether or not they perform exercise testing with electrocardiography when sporting bodies require testing prior to participation and when commercial parties are offering these tests<sup>19</sup>. For athletes it can be very difficult to make such a complex choice and it is debatable who has to take the responsibility to provide this choice. Healthcare providers who are working in this field should think about this argument. Umbrella guidelines for pre-participation examination in athletes can help to prevent overdiagnosis in sports medicine on a broader scale.

##### *Injury diagnosis and rehabilitation*

In the example of imaging after rehabilitation of musculoskeletal injuries, prevention of overdiagnosis is easier to accomplish if the sports physician is willing to achieve this. If, for example, an athlete has fully completed a rehabilitation programme after an acute hamstring injury and requests additional imaging before return to play, it is crucial to convince the athlete that this is not necessary. If the treating doctor tells the athlete that performing an MRI will result in a high probability of finding abnormalities and that the only



change from 'normal' clinical management will be an unnecessary delay in return to sports and increase in doubts during return to play, many athletes will understand that imaging will not aid in this situation. A direct but simple response to the requesting athlete could be: 'we can request an MRI but the most likely result is that we have to keep you out of play for longer if we rely on the MRI results.' Adequate information will result in the prevention of overdiagnosis in the majority of these cases.

## CONCLUSION

As healthcare providers in sports medicine, we all sometimes make choices that can result in overdiagnosis. It is often hard to oversee the complexity of these decisions. The major aim of this article is to describe the problem of structural overdiagnosis in sports medicine on a larger scale. It is important to be aware that information about the risk of getting an injury or disease based on risk factors in asymptomatic athletes can negatively influence their perception of health, quality of life and performance. The potential for overdiagnosis should be recognised by healthcare providers with the ultimate aim of improving athlete's health with less medicine.

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