The administration of any pharmaceutical agent to a professional or elite sportsman is fraught with danger. There is the risk of giving a banned substance to an ailing athlete and destroying a career. Then there are the potential problems of drug interactions with any of the multitude of agents that the sportsman may be taking. One should also be alert to being asked to treat the side-effect of a banned, illegal, experimental or veterinary agent. The rules for banned substances apply not only to able-bodied athletes, as athletes with disabilities are governed by the same rules and may need treatment for their chronic conditions.

Drug testing

Drug testing is expensive, so tests are conducted at random, or target an individual who has produced previously suspicious, but not yet positive, tests.

Not all agents are examined with every test, which generally look for those that would be beneficial in that sport specifically, for example beta blockers in archery or stimulants in sprinters.

Testing protocols are carried out via national and international federations responsible for running the different sports under the auspices of the World Anti-Doping Association (WADA).

Two basic types of testing are performed:

• Out of competition: Test for steroids, erythropoietin, growth hormone, insulin-masking agents and those that help in building strength or endurance or aiding recovery during training. These tests can be done anywhere, at any time. A certain pool of international sportsmen is required to provide details of their whereabouts, offering a 60 minute availability period in which they can be tested every day of the year.

• In competition: In addition to the above agents, stimulants or beta blockers and opioids are tested for during competition, as these agents raise performance briefly with short half-lives. Recently blood transfusions, whether autologous or homologous, can be tested for, along with plastination agents that are found in infusion systems.

Therapeutic use exemption (TUE)

Athletes are allowed to use certain products which are on banned lists if the use of that agent is needed to treat a chronic or emergency medical condition (such as \( \beta_2 \)-stimulants in asthmatics). This is provided that no alternative agent is available, an application for the TUE has been submitted at least 21 days prior to competition, and permission has been given by the international federation or WADA for the TUE (which has an expiry date). No retrospective permission is given after a test is done. In addition, a declaration of use must be made for the agent at the next test.

Corticosteroids are the only agent that can be declared at the time of testing for a TUE, provided they have not been systemically administered, for example through local injection, topical cream and nasal spray, and not orally or intravenously.

When prescribing for an elite sportsman, these are the questions that need to be asked and here is the thought process that should be followed:

• Is this agent on the banned list? If in any doubt, look it up on http://www.drugfreesport.org.za.
Refresher Course: Anaesthesia and analgesia drugs contraindicated in competitive athletes

• Is there an alternative agent that is not on the banned list? If not, is it necessary to apply for a TUE, or to avoid the agent? If the agent is only banned for “in competition” and there is no alternative, the following questions should be considered:
  • What is the half-life of the agent?
  • When will the sportsman return to play competitively?
  • What is the likelihood of being tested and when is this expected to happen? In-competition agents can be used provided they are not detected when the sportsman competes next.

Table I, while not complete, is a rough guide to anaesthetic administration. Some of the products, such colloids and diuretics, appear to be misplaced on the banned list, but they have been included because they are sometimes used as masking agents to dilute or alter urine composition.

### Table I: Agents of concern in anaesthesia

<table>
<thead>
<tr>
<th>Safe</th>
<th>Banned in competition</th>
<th>Banned at all times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propofol</td>
<td>Fentanyl</td>
<td>Corticosteroids</td>
</tr>
<tr>
<td>Ketamine</td>
<td>Sufentanyl</td>
<td>Erythropoietin</td>
</tr>
<tr>
<td>Thiopentone</td>
<td>Alfentanil</td>
<td>Colloid fluids</td>
</tr>
<tr>
<td>Etomidate</td>
<td>Morphine</td>
<td>Dextran</td>
</tr>
<tr>
<td>Midazolam</td>
<td>Pethidine</td>
<td>Albumin</td>
</tr>
<tr>
<td>Local anaesthetics</td>
<td>Cocaine</td>
<td>Mannitol</td>
</tr>
<tr>
<td>Muscle relaxants</td>
<td>Cocaine</td>
<td>Furosemide</td>
</tr>
<tr>
<td>Tramadol</td>
<td>Pentazocine</td>
<td>Spironolactone</td>
</tr>
<tr>
<td>Codeine</td>
<td>Ephedrine</td>
<td>Diuretics</td>
</tr>
<tr>
<td>Paracetamol</td>
<td>Pseudoephedrine</td>
<td>Acetazolamide</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>Beta blockers</td>
<td>Insulin</td>
</tr>
<tr>
<td>Anticoagulants</td>
<td>(certain sports)</td>
<td>Salbutamol</td>
</tr>
</tbody>
</table>

### Anabolic steroids

**Testosterone precursors**
Testosterone precursors and dihydrotestosterone have been used in an attempt to increase the level of testosterone in the body. All these agents are banned substances (except in professional American baseball).

Side-effects: ↓ HDL and ↑ LDL and triglycerides, ↑ oestriodial with ↑ incidence of gynaecomastia and malignancy, acne, baldness and hirsutism, atrial fibrillation, hypertension, mood and libido changes, headaches, abdominal pain and oedema.

**Clenbuterol**
This is a β₂-agonist with a half-life of 35 hours that is used in asthma. It is used to increase muscle mass and strength, and is especially effective when used in conjunction with anabolic steroids. It is used to prevent muscle loss after an anabolic steroids course. It is banned and illegal in most countries (veterinary product used to fatten beef).

Side-effects: Tremor, tachycardia and arrhythmias. There have been two anecdotal reports of sudden death in bodybuilders.

**Insulin**
Insulin is popular in power sports due to its anabolic properties. It is often used in combination with one of the anabolic hormones.

Side-effect: Unexpected hypoglycaemia.

**Human growth hormone (hGH)**
This is almost undetectable and popular, since recombinant hGH removed the worries of Creutzfeldt-Jakob disease. It is an effective power and mass builder, especially when used in combination with anabolic steroids and insulin-like growth factors.

Side-effects: Acromegaly (only anecdotal reports), coronary artery disease and congestive cardiac failure.

**Insulin-like growth factors**
These aid the effects of GH. There is uncertainty about its role in sports.

Side-effects: Hypoglycaemia, hypophosphataemia, hypotension and asystole, Bell’s palsy and avascular necrosis of the femoral head.

### Methods of improving oxygen transportation

**Blood doping**
This is an infusion of homologous or autologous blood donated up to a month pre-competition. It increases DO₂ significantly. It results in problems with hyperviscosity and transfusion reactions.

**Erythropoietin (EPO)**
This is commonly used amongst cyclists, endurance sportsmen and distance runners. It raises the haemoglobin to pathological levels, and is particularly useful if used in conjunction with haematinics. Use of micro-doses and slow release second- and third-generation products have increased since testing for EPO became available.

Side-effects: Hyperviscosity, worsened by dehydration seen in endurance sports, deep vein thrombosis, deaths from pulmonary emboli, or sudden death occurring during sleep.
Perfluorocarbons (PFCs)
These have been used in an attempt to increase O₂ delivery. PFCs only work at PaO₂ above 200 mmHg.

Non-human haemoglobins
HBOC and other non-encapsulated haemoglobins are reported to be used, despite their limited registration for human use.

Side-effects: Haematuria, renal failure, uncontrollable hypertension (HBOC is a NO scavenger), hypervolaemia, hyperviscosity and bovine spongiform encephalopathy.

Colloids
Due to the problem of increased viscosity with most of these products, colloids or dextrans are often used to diminish the viscosity and dilute the haematocrit below 50%. This is the value used to indicate haematological manipulation. They can also be used to dilute urine samples, masking other agents.

Gene manipulation
This is achieved by the transfer of RNA or DNA, or using agents that alter gene expression.

Diuretics
These are used in sports that are contested in weight categories and to dilute urine to pass a drug test. Probenecid is used to alter the urine specimen. It is difficult to obtain TUE for diuretics.

β-blockers
These are used to calm shotists and archers. They are banned unless required for a medical condition.

Stimulants
These are common in many over-the-counter preparations such as cough mixtures, cold and flu therapies, appetite suppressants and weight-control methods. Banned substances include amphetamines (side-effects: tachycardia, arrhythmias, hypertension, angina and aggressive behaviour), adrenaline, ephedrine and pseudoephedrine.

Narcotics
These depress fear, anxiety and pain centrally. They are all banned, except codeine which has been reinstated recently.

Cocaine
This is the most commonly abused drug in professional sports in the USA. It is used recreationally and as a narcotic and stimulant. It works via inhibition of reuptake of noradrenaline and dopamine.

Side-effects: Septal necrosis arrhythmias, tachycardia, hypertension, myocardial infarction, CVA and sudden death.