

History of anabolic steroids misuse and drug testing



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Introduction:

History of drug abuse

Drug abuse in sport is not a recent issue. In Ancient Greece, the Olympic athletes used special diets (herbs, mushrooms and sesame seeds) to improve their physical performance. The gladiators in the Roman times, consumed stimulants to reduce fatigue.(1, 2) South American Indians used coca leaves to enhance stamina.(2)

During the nineteenth century, drug abuse became a great problem. Caffeine, strychnine, alcohol, cocaine, opium, and oxygen were used by swimmers, runners and cyclists to increase performance.(1, 2) In 1896, the cyclist Arthur Linton was the first reported fatality case in sport from strychnine intake which was administered by his coach.(1) Later on, in 1904, the runner Thomas Hicks, was near to death in Olympic Marathon in St Louis USA, from use of strychnine and brandy.(1)

During the Second World War, amphetamine consumption started by the troops to reduce their fatigue. In 1940s and 1950s, amphetamines substitute other drugs in its use in sport.(became the choice over other drugs). (1)

Reported deaths from amphetamine abuse was in 1964, the Danish cyclist knut Jensen at Rome Olympics died on the opening day of the games. In 1967, the British cyclist Tommy Simpson, at Tour de France, died from amphetamine abuse. After Simpson's death, the International Olympic Committee took an action and the first list of banned substances was published in 1968.(1, 3) In 1950s, a new class was misused by athletes and

weightlifters to increase muscle size and strength and this class named anabolic steroids;(1) in 1964, there was suspect for use of anabolic steroid in Summer Olympics in Tokyo due to the increase in muscle mass of the athletes.(3)

Top scandals in drug abuse

1. East German athletes(4, 5, 6)

From 1972 to 1988, the East German which was a country of 17 million populations, won 20 to 40 gold medals in 4 years and became a country competing the United States and Soviet Union. Manfred Ewald who was the head of Olympic sport committee in East Germany, and Dr. Manfred Hoepfner who was the sports doctor at that time, were responsible about giving the athletes banned substances intentionally without their knowledge. This results in severe complications in the athlete's health such as liver dysfunction, cancer, hormonal changes and infertility.

From 1966 and on, many doctors and coaches in East German follow a plan which was sponsored by the government known as " systematic and overall doping in competitive sports". After the collapse of East German and Berlin Wall fall in 1989, many athletes confessed about the pills and injections that were given to them. Kornelia Ender, Barbara Krause and Carola Nitschke were three of the thousands of East German athletes who had provided with steroids. Heidi Kreiger was also one of the athletes that was provided with steroids heavily and this was the main reason that force her to make sex-alteration operation.

2. Pan American Games in 1983

IOC included testosterone in the banned list in 1983 and it was the first endogenous substance to be tested at that time. The test was based on measuring the testosterone to epitestosterone (T/E) ratio. (1)

The first drug testing for steroids was at the Pan America Games in Caracas and Venezuela in 1983. Around 15 athletes were caught at these games. Jeff Michaels, the American weightlifter, and Guy Greavette, the Canadian weightlifter, were tested positive for steroids. They returned their medals and being suspended for 2 years. (5, 7)

Many athletes of the U. S track-and-field team withdrew from the game rather than being captured. (7)

3. Ben Johnson's scandal

In 1988, the Canadian Ben Johnson was stripped of his gold medal at 100 meters after he has been tested positive for the anabolic steroid stanozolol at Seoul Olympics. Johnson has been banned from competition for 2 years. (7)

4. Michelle Smith: the Irish swimmer(5, 7)

In 1998, the Olympic champion swimmer Michelle Smith was tested positive for banned substance at her home through out-of-competition testing. The test was positive for alcohol in an amount that would be fatal if taken by an athlete. So FINA, the international governing body for swimming, concluded that the urine sample was treated with alcohol as a masking agent and Smith has been suspended for four years.

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5. Chinese swim team(5, 7)

The Chinese national swim team has been used anabolic steroids, erythropoietin and human growth hormone in the last 15 years. In 1992 Barcelona Olympics and 1994 world championships, china won a high number of gold medals. In world swimming championships, a world records was set by women swimmers, and this causes suspect that they were using drugs. In 1994 at Asian Games, eleven athletes were caught as drug abusers for dihydrotestosterone. Since 1990, over 40 Chinese swimmers were tested positive for abused drugs and at that time china reached the peak for drug abuse over the swimming countries.

6. Tour de France(5)

Doping by cyclists arises since 1967 after Simpson death at Tour de France due to amphetamine misuse. Drug abuse by cyclists continues and in summer 1998, the Festina cycling team was pushed out from the competition at Tour de France after the French Officials found EPO in their masseur's car. After investigations, six of Festina's nine riders confessed that they had taken abused drugs. Later on, the leader also has failed drug tests for anabolic steroids. Also in 2002, Stefano Garzelli, the leader of the Vini Caldirola team, has failed drug test for probenecid, a diuretic which is used as a masking agent. Also in the same year at Tour de France, the Spanish cyclist Igor Gonzalez de Galdeano, was tested positive for anti-asthmatic drug. In January 2004, two cyclists in the Cofidis team, which is one of the top teams in france, were caught as drug abusers for EPO and amphetamines.

7. Steroids in baseball (5)

In 2002, a report was published by the Sports Illustrated and the National League MVP Ken Caminiti stated that “ at least half the guys are using steroids.”

In 2003, the Major League Baseball revealed that around 7% of 1438 tests on all players were positive for steroids.

8. Doping in skiing(5)

Drug abuse in cross-country skiing has been spread for years especially with EPO. In 2001 world championships in Finland, six finish skiers have failed drug test for HES which is a plasma volume expander. Three skiers at the Salt Lake Games were tested positive for the drug Darbepoetin which is a synthetic compound of the natural hormone EPO. Two of these athletes Olga Danilova and Larissa Lazutina were Russian medalists but later on, they were stripped of their medals and the gold medal was awarded to the Canadian Beckie Scott who ended third.

9. BALCO scandal

BALCO is Bay Area Laboratory Cooperative which is a company that provides nutritional supplements. Victor Conte built BALCO in 1984 and he followed a system for analyzing urine and blood in order to prescribe supplements that replace vitamin and mineral deficiencies. Tetrahydrogestrinone is one of banned substances that was used by BALCO and was undetected by drug testing. THG or “ The Clear” is an anabolic steroid that can reduce fatigue during training and can increase the muscle mass. In 2003, the USADA,

United States Anti-Doping Agency, developed a test for THG after receiving a syringe from anonymous (US track coach Trevor Graham) containing THG and claiming that most athletes are using this drug. Don Catlin, succeeded in developing the test and he tested the urine samples that were taken from athletes at the US championships and numerous tests came back positive for THG(8, 9). Athletes that were involved in BALCO scandal were Kelli White, Marion Jones, C. J. Hunter, Tim Montgomery, baseball star Barry bonds, and NFL's Bill Romanowski, and Dwain Chambers. In 2004, Dwain Chambers who was the European 100m champion at that time was banned from competition for 2 years. 100m and 200m Champion kelli white was banned for 2 years as well. USADA convicted BALCO, for the distribution of THG. In 2005, Victor Conte was jailed for four months. Greg Anderson (Barry Bond's trainer) was jailed for three months.(9, 10, 11, 12)

10. Ma's runners

Ma Junren was the coach for the world female championships runners(13). In 1993, Ma's Chinese female runners won three gold medals at the World Track and Field championships in Stuttgart and also in 1997 they set world records. From that time there was suspicion that the runners were using banned substances(13, 15). A doping scandal for Ma's runners arose before the 2000 summer Sydney Olympic(14, 15). Top runners like Liquing Song and Lili Yin had failed drug test for testosterone during an out-of competition testing in 2000 and the Ma's Chinese runners were evicted from the Olympic team(13, 15).

History of drug testing:

Doping was also done for race horses not and only for humans. The first drug test was done for alkaloids on the saliva of horses in 1910 by a Russian Chemist in Vienna.(1, 2)

Drug testing on human urine started in 1950s after the wide spread abuse of amphetamines. (7)

After British Tommy Simpson death from amphetamine abuse at Tour de France in 1967, IOC established the Medical Commission and a list of banned substances was established by the IOC. Professor Beckett was a member in the Medical Commission at that time and he developed methods for detection of stimulants , i. e. drugs that were used” in competition”. (3, 7)

Methods of Beckett for drug testing were first used in 1968 at Mexico City Olympic competition and these tests were for non-steroidal drugs (narcotic analgesics and stimulants) and there was no tests for anabolic steroids.(7) (3). The first formal drug testing programmes for narcotics and stimulants was in 1972 at Munich Olympics. These tests were done at the competition periods.

The abuse of Anabolic steroids became prevalent in 1970s and its use was banned in 1974 by the IOC and added to the list in 1975(1) p313. The first formal steroid testing program occurred in 1976 at Montreal Olympics using radioimmunoassay screening for detection its presence and GCMS for confirmation. (7, 19)

In and out of competition testing:

At first testing programmes were based on tests during the competition periods. But later on it was recognized that these tests were of limited value to catch up the cheats. Athletes learn how to defeat the testing programmes by calculating the clearance time of the drug in the body so they could avoid its use before the competition periods. From here came the “ out -of - competition” testing programmes to catch the cheats for drug abuse. “ Out of competition testing” started in late 1970s. The first out of competition testing was conducted in 1977 by Norway and in UK, it started in early 1980s. However, the “ out- of -competition” testing did not expand globally until the establishment of WADA in 2000. WADA established out-of-competition testing programmes and it was followed globally from that time.

(1) p314-315

Classification of Abused Drugs

Doping

classes

examples

and

methods

Anabolic

Testosterone,

steroids

nandrolone

(discussed later

Blood transfusion (discussed later)

Stimulants Amphetamine, ephedrine, cocaine, caffeine

Narcotics Morphine, Methadone, Codeine

Peptide hormones and glycoproteins Human growth hormone, corticotrophin, chorionic gonadotrophin, erythropoietin

Diuretics and masking agents Acetazolamide, Furesamide, Probenecid

Beta-blockers Atenolol, Propanolol,

Metoprolol

Atenolol, Propanolol, Metoprolol

Anabolic steroids (discussed later)

Blood Dopping (Blood Transfusions) (discussed later)

Central Nervous System Stimulants

Athletes often use stimulants to enhance alertness and reduce fatigue i. e. increase physical and mental performance. 1p41. These are more used on the day of competition to reduce the sensitivity to pain of athletes if they got injured; however, nowadays they are used during training to increase training time.

Amphetamines

Amphetamine is a synthetic compound (1920), it was developed as an appetite suppressant and for treatment of narcolepsy, to fight fatigue and to enhance alertness, but later it was withdrawn from clinical use due to the development of tolerance. P42

Methamphetamine is very addictive stimulant, related to amphetamine with more longer lasting and toxic effects on the CNS.

Mechanism of action:

These are indirectly acting sympathomimetic amine. They enter neurons and act presynaptically to release stores of noradrenaline, and dopamine from

nerve endings; they also block noradrenaline and dopamine transporter reuptake and inhibit MAO.

They include Dexamphetamine, Methamphetamine, Phenmetrazine, and methylphenidate.

Routes of administration:

Amphetamine can be administered orally, nasally, and intravenously.

Amphetamine itself is not very effective if smoked. Methamphetamine is smokable form and it is becoming increasingly popular as a drug of abuse.

Effects of Amphetamines in Sport:

Athletes often use amphetamine to reduce fatigue, increase alertness and concentration, increase euphoria and to tolerate painful injuries. p42. p72

Side Effects:

The most important side effect is heart stroke. p72. Amphetamines cause peripheral vasoconstriction and thus increase blood pressure. The body overheats and cannot regain its temperature resulting in dehydration. 1. p42

The second side effect is that the euphoric action may affect the awareness of athletes and thus they fall in misjudgements.

Cases of amphetamine abuse:

Amphetamine use was spread around the time of the Second World War, to decrease fatigue of the troops. Later, its use was spread among athletes in 1940s and 1950s. 1. p30. its use started to be controlled under the UK Misuse of Drugs Act 1971.

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In 1960, the cyclist, Knud Jenson, died due to amphetamine abuse in the intense summer heat of Rome Olympics. 1p72-30

In 1967 Tour de France, the British cyclist, Tommy Simpson, died as a result of amphetamine abuse while climbing the infamous Mont Ventoux. His death was due to cardiac arrest. 1p72

In 1997, American Footballers, (Clarkson and Thompson), withdrew from play due to amphetamine abuse which was taken to tolerate injuries. 1p72

Effect on behaviour Mandell (1979), Golding(1981)

In 2002, the British skier Alain Baxter, had lost his Olympic bronze medal and he was banned from skiing from March until June, due to positive test of Methamphetamine(l-form which is found in OTC vicks inhaler. IOC test do not distinguish between l- and d- form. D-form is used as performance - enhancing drug. Later on, Baxter's name was cleared as being a drug cheater and it was approved that the drug was l- form.(16, 17, 18)

Ecstasy

It is a synthetic amphetamine derivative. It was synthesized in 1914 as an appetite suppressant. It has stimulant amphetamine like properties, now commonly used in dance clubs but it may be misused by athletes.

In UK, it was classified as an illegal substance since 1977, and in USA its use was under control since 1985.

Since 1990, there were no reports for ecstasy misuse by athletes. p73

Ephedrine and related compounds

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Ephedrine is a natural product occurring in the plant genus Ephedra.

Phenylnopropanolamine and pseudoephedrine are synthetics. These are used to treat cold symptoms as bronchodilators. 1. p73. p42.

Mechanism of action

It has sympathomimetic action. These deplete noradrenalin from neuronal storage sites resulting in indirect effect on sympathetic neurons and CNS. 1. p73

Routes of administration

Ephedrine and phenylpropanolamine are found in cold medications (in UK and USA) which are taken orally. Phenylpropanolamine is now prohibited by US authorities. 1. p74

Effect of Ephedrine in Sport

Ephedrine is misused by athletes for its euphoric action. 1p42. Athletes try to misuse ephedrine because its use could be negotiated due to its presence in the over-the-counter medication. 1p42

Side effects

The main side effect is the cardiac arrhythmias.

Cases of Ephedrine abuse

Pseudoephedrine, phenylpropanolamine, and phenylephrine were removed from WADA list for banned substances in 2004, but they are still controlled by WADA for athlete's misuse. Ephedrine is still on the banned list. 1p76

In 1972 Olympics, the US swimmer, De Mont, was banned due to urinary ephedrine positive test in which he declared that its presence due to a medicine. 1p76

In 1988, Linford Christie, at Seoul, was tested positive for cold cure substance, and he was nearly to lose his silver medal.

Cocaine

Cocaine was a component of Coca-Cola until it was classified as an illegal drug and it was removed in 1903.⁽¹⁾The main therapeutic effect is its use as a local anaesthetic.

Mechanism of action

Cocaine exerts its sympathomimetic central effects by inhibiting the reuptake of noradrenaline, dopamine, and 5-HT into presynaptic terminals of the mesolimbic reward/pleasure pathway.

Routes of administration

“ Snorting” is the most common route of administration of cocaine. The powder is drawn up to the nose, and is absorbed through the nasal epithelium into the blood. It reaches the brain within about three minutes.

It can also administered by intravenous injection, reaching the brain in 15 seconds and the effects last for 15 minutes.

Crack cocaine is smoked in a pipe, absorbed rapidly in the lungs and reaching the brain in about 5 seconds.

Effects of cocaine in sport

It was misused in sport due to its euphoric effect and due to reduction of fatigue.

Side effects

Its side effects are: tachycardia, hypertension and at high dosage, tremors and seizures may occur. Cardiotoxic metabolite may result due to concomitant use of cocaine with alcohol and anabolic steroids.

Reported cases of cocaine misuse

Len Bias, the US basketball player, and Don Rogers, the American footballer died from cocaine abuse.(1)

Caffeine

Caffeine is the most popular used drug which is found in many beverages like coffee, tea and soft drinks. Caffeine was banned by IOC but then it was withdrawn from the list by WADA in January 2004. However, its use is still monitored by WADA. Quantitative measurement for caffeine in the urine was established in 1984 at the Olympic Games in Sarajevo and Los Angeles. IOC set the level in the urine at 15 micrograms per millilitre and then in 1988, it was decreased to 12 micrograms per millilitre. Studies showed that 1000mg doses of caffeine are required to excrete caffeine in the urine at levels more than 12 micrograms per millilitre.

Routes of administration

It is taken as tablets or injections(1)

Effects of caffeine in sport

High doses are required in sport to decrease fatigue and increase concentration.(1)

Side effects

tremors

Narcotic analgesics

These are called opiates. Raw opium contains morphine and codeine which have strong analgesic properties. Drugs that are usually misused are: Morphine, heroin, and methadone. All opiates were banned by IOC except dextromethorphan, pholcodeine, and diphenoxylate. Codeine was first banned but because many sports federation had refused that so it was then removed from the list due to its presence in many over-the-counter medications.

Mechanism of action:

Opiates bind to specific opiate receptors in the brain and spinal cord, and also interact with endogenous opiate peptides, enkephalins and endorphins, in mediating emotional highs and in the process of addiction. p(1)-23

Routes of administration

Opiates are taken orally, by injection or by inhalation.

Effects of narcotic analgesics in sport

These are used for their euphoric and analgesic actions. They are used to mimic the injury during training or competition.

Side effects

These include vomiting, diarrhea, dry mouth, skin itching, loss of concentration, drowsiness, comas, and addiction. At high doses it may cause respiratory depression.(1) p24,, BBC

Diuretics and other masking agents

Diuretics are drugs that are used by people to remove fluid in order to decrease blood pressure. Examples are: furesamide, acetazolamide and chlorthalidone.

Effects of diuretics in sport

Diuretics are misused in sport to overcome the side effect fluid retention that is cause by athletes misusing anabolic steroids. They are also used to lower the athlete's weight in sports that competition occurs in weight groups. P46red and BBC. Also diuretics are used to increase the flow of urine and hence increase the rate of excretion of abused drug or its metabolite in the urine so the abused drug could not be detected.

Side effects

These include: muscle cramps, dehydration, headache, nausea and kidney damage.

Probenecid is used as making agent to disguise the presence of banned drugs and their metabolites by inhibiting the excretion of these through the kidney. p47 red.

Probenecid is no more used because the use of gas chromatography and mass spectrometry can detect its presence and catch up the cheats.
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Beta blockers

These were added to the list of doping classes in 1985. But because of its therapeutic use, the IOC in 1993 added them in the “ classes of drugs subject to certain restrictions “ part .

They were used by athletes to increase their performance by increasing the cardiac output increasing blood flow to muscles. p-48-49 red

Peptide and glycoprotein hormones

These are natural substance that are produced by the body. BBC -doping I sport

Effects in sport

- Corticotrophin: it induces the release of the adrenal corticosteroids thus mimic the pain after injury. (1)p47
- Human Growth hormone(HGH) and chorionic gonadotrophin(HCG) : it has anabolic effect, so it increases size and strength of muscles. BBC
- Erythropoietin: it is a peptide hormonep48(1). It increases red blood cell production thus increasing the oxygen transfer by blood , ie. Increase in the performance . BBC.

Side effects

HGH has main side effect that is, it may cause acromegaly. BBC

EPO has main side effect that is, it may thicken the blood, resulting in heart attacks. BBC

Chemical and physical manipulation

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It is the changing of urine sample by using substances or procedures in order to conceal the detection of a banned substance. Examples of manipulation are: the use of other's urine, use of vinegar to affect the urine, epitestosterone to alter the ratio. BBC news, doping

Anabolic Steroids

What are Anabolic steroids?

Testosterone was isolated in 1935.(2)p52. It is an endogenous steroidal hormone male hormone produced by testes in men. steroid 7. It is synthesized from cholesterol like all other steroidal hormones. Steroid 7. Epitestosterone is a testosterone isomer and found in a small ratio with respect to testosterone. Steroid7.

Testosterone is responsible for the androgenic and anabolic effects. steroid7. The androgenic functions of testosterone are responsible for the modifications in the primary sexual male features. Steroid7. , while the anabolic effects are responsible for enhancing muscle growth, protein synthesis and erythrocytes. steroid 7.

Anabolic steroids are group of synthetic modified derivatives of testosterone. steroid 10. When administered, they bind to the androgen receptors which are found in the prostate, skeletal muscle and central nervous system to give their mechanism of action. Their structure is developed and modified to improve the anabolic effects with decreased androgenic effects. steroid 10

Routes of administration

Anabolic steroids are administered orally or intramuscularly. Nowadays, athletes are using transdermal patches, sublingual tablets, nasal sprays, and dermatological gels of testosterone to escape positive tests(2). P 3

Why do athletes misuse anabolic steroids

Athletes use anabolic steroids due to their anabolic effects, so they are used due to its positive effect on the skeletal muscle tissues. They are used to increase strength and muscle size. They are also used to increase body weight, protein metabolism and collagen synthesis. Steroid 6 and 35 . Some athletes use anabolic steroids because they “ want to be big”. steroid 7.

Side effects

- Cardiovascular effects:

Anabolic steroids ingestion results in severe coronary heart disease. They reduce high density lipoprotein (HDL) and increase low density lipoprotein (LDL). Steroid 25- steroid 7. resulting in atherosclerosis.

- Increase heart stroke

Anabolic steroids increase blood clotting and thus favouring thrombosis resulting in heart attacks. steroid 26

- Liver problems

Oral anabolic steroids results in cholestatic hepatitis and jaundice. steroid 7, 26 Also increase in the liver enzymes(aspartate amino transferase, alanine amino transferase and lactate dehydrogenase) is encountered with the use of steroids. steroid 37

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- Sexual side effects

High doses of anabolics in a study by Holma, shows that the sperm counts decreased by 73% and azoospermia occurred for 3 individuals i. e affecting fertility. Steroid 7

They affect secretion of the reproductive hormones like testosterone and thus reducing libido due to decrease level of luteinizing hormone (LH) and follicle stimulating hormone(FSH). sterodi 37. Anabolic steroids abuse may result in prostate cancer. Steroid 37

- Gynaecomastia

It is the enlargement of the mammary tissues in men due to transfer of androgens to estradiol and estrone. steroid 7, 37

- Psychological effects

A study in USA showed that anabolic steroids revealed changes in mood such as mania and depression. steorid7

Other side effects include: hyperinsulinemia, hypertension, tendon damage, steroid 26. edema, muscle spasm, acne hirsutism, and deepening of voice. Steroid 35

History of anabolic steroids misuse and drug testing

The use of banned substances such as caffeine, cocaine and strychnine started during the 19th century in most of the sport events like cycling, swimming, and distance running. steroid 26.

The abuse of steroids in sport started in 1950s by the soviet weightlifting teams. p54 green, steroid26. In 1960 Olympic Games, anabolic steroids use was restricted to Soviet weightlifting, but by 1964, their use is increased in all strength sports. p45 green. 7. Anabolics use became more common in most sports in 1972 Olympic Games. Steroid 26

Anabolic steroids use has been banned by medical commission of IOC in 1974 and has been added to the list of banned substances of IOC in 1975. steroid 10, 7

Although the first formal testing was introduced in 1972 Munich Olympics, there was no testing for anabolic steroids (7). P4. The first formal test for anabolic steroid was in 1976 Montreal Summer Olympics(7). First positive tests for steroids were in 1976 Montreal Olympics, in which 8 athletes, seven weightlifters and one female athlete in a field event were caught for steroid abuse(7). p75., while no positive tests were reported in 1980 Moscow Olympic Games.

Anabolic androgenic steroids are one of the most widely used drugs by athletes to enhance their performance and physical appearance. Steroid 6. Their use extends to be not among professional athletes but also among high school male and female students. Steroid 26

WADA accredited laboratories published statistics form 1993 till 2003 and this showed that anabolic steroids are the most widely used banned substances. p32. red.

1993 199 200 200 200

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	4	1	2	3	
stimula	22.	24	15.	14.	1
nts	8%	%	4%	9%	9
					%
Anaboli					3
c	59.	50.	40.	36.	2.
steroids	9%	5%	1%	8%	1
					%

Unlike amphetamines and other stimulants which were taken on the day of competition (which causes sudden death due to cardiac arrest), anabolic steroids are administered during the training exercise and not before the competition periods. P31 red. they are taken in cycles with duration of six-twelve weeks, and usually 2-3 cycles are taken in a year. Steroid7.

The introduction of the “ out of competition” testing programmes limited the use of the anabolic steroids. P46 red

Systematic doping: biggest scandal

One of the biggest scandals for steroid abuse was in the German Democratic Republic, they were used from 1965 to 1989 and this allows the East German to win many medals. Coaches and doctors in East Germany follow a programme for systematic doping with steroids. In 1965, a pharmaceutical company had developed chlor-substituted derivative of methandrostenolone (Oral-Turbinabol R), and from 1968 GRD started to introduce it to female athletes in the Olympic Games. Steroid 40

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Detection of anabolic steroids:**Detection of urinary anabolic steroid by radioimmunoassay**

Drug testing was based on radioimmunoassay screening of urine samples from athletes for detection of banned substances and then gas chromatography/mass spectrometry for confirmation the positive tests (7). Testing at that time was insensitive and not selective due to the fact that testing was done during competition periods and anabolic steroids were usually taken for long periods, so athletes used to quit these drugs at competition periods so their level will decrease in the urine and could not be detected and the tests would give false negative (19).

Detection of urinary anabolic steroids by GC/MS, measuring testosterone to epitestosterone (T/E ratio)

Drug testing at that time could not differentiate between endogenous testosterone and synthetic anabolics. steroid7.

Testosterone was introduced in the banned list of IOC in 1983, it was the first endogenous substance to be banned, after the discovery of the detection method in 1982. p35red.

In 1984 Olympic Games, all urine samples from athletes were screened by GC/MS for detection and identification. The T/E ra