



Lecture 34:

Substance Abuse in Sports (Doping) Part 2

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Blood Doping:

- It is the administration of the blood or any blood components for the sole purpose of enhancing performance in sports.



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- It is prohibited by WADA (world anti - doping agency).
 - The first confirmed case of blood doping was reported in **Montreal Olympic Games 1976**: by long distance runner, from Finland.
 - reindeer milk.

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graph TD; A[Blood Doping] --> B[Increase in the Red Blood Cells]; B --> C[20% increase in Oxygenation];
```

Blood Doping

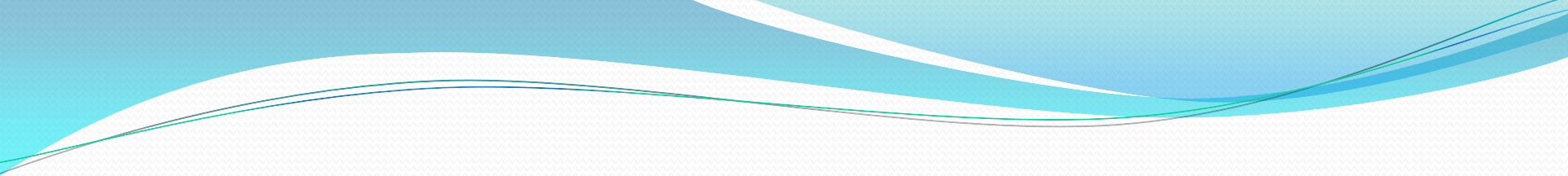
**Increase in the
Red Blood Cells**

**20% increase in
Oxygenation**



According to WADA, the followings are prohibited:

- **1)** The Administration or reintroduction of any quantity of autologous, allogenic (homologous) or heterologous blood or red blood cell products of any origin into the circulatory system.
- **2)** Any form of intravascular manipulation of the blood or blood components by physical or chemical means.

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- **3) Artificially enhancing the uptake, transport or delivery of oxygen. Including, but not limited to:**
 - **Perfluorochemicals.**
 - **Efaproxiral (RSR₁₃).**
 - **EPO (Erythropoietin).**
 - **Modified haemoglobin products, such as:**
 - **haemoglobin-based blood substitutes.**
 - **microencapsulated haemoglobin products.**

Blood Doping

```
graph TD; A[Blood Doping] --> B[Old Methods]; A --> C[New Methods]; B --> D[Blood Transfusion]; D --> E[Autologous]; D --> F[Homologous (Allogenic)]; D --> G[Heterologous]; C --> H["- EPO<br/>- Hb Enhancers<br/>- Perfluorochemicals<br/>- Efaproxiral (RSR13)"]
```

The diagram is a hierarchical flowchart. At the top is a red box with the text 'Blood Doping'. Two arrows point down from this box to two separate red boxes: 'Old Methods' on the left and 'New Methods' on the right. From 'Old Methods', a large blue arrow points down to a yellow box labeled 'Blood Transfusion'. From 'Blood Transfusion', three arrows point to three stacked blue boxes: 'Autologous', 'Homologous (Allogenic)', and 'Heterologous'. From 'New Methods', a large blue arrow points down to a yellow box containing a list of four items: '- EPO', '- Hb Enhancers', '- Perfluorochemicals', and '- Efaproxiral (RSR13)'.

Old Methods

Blood Transfusion

Autologous

Homologous
(Allogenic)

Heterologous

New Methods

- EPO
- Hb Enhancers
- Perfluorochemicals
- Efaproxiral (RSR₁₃)

- **Autologous blood transfusion** is the collection and re-infusion of the person's own blood or blood components.
- **Homologous (allogenic) blood transfusion** is collecting and infusing the blood of a compatible donor into him/herself.
- **Heterologous blood transfusions** are those that involve someone infusing blood and its components from a different species.

Autologous Blood Transfusion:

**Athlete is taken to high altitude
3 - 7 days before competition**



Extracting Blood



**Storing for Competition Day:
Liquid form: 6 weeks in - 4 C degrees
Frozen form: few years in - 80 C degrees**



**Re-infusion of blood products
to athlete on competition day**

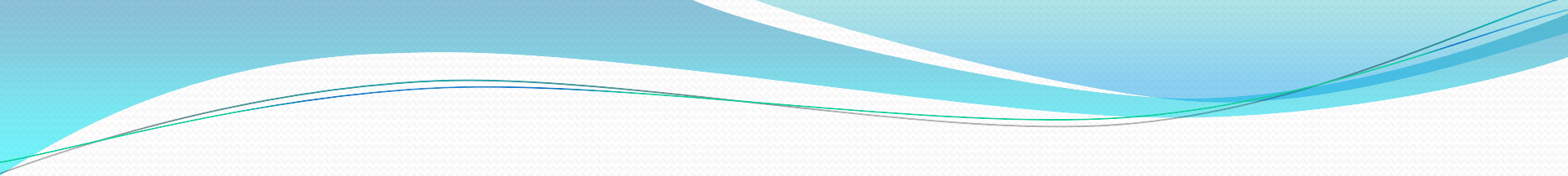
Technical difficulties of Blood Doping, transfusion type:

- **1) Needs a medical team.**
- **2) Requires a highly sterilized environment.**
- **3) Needs equipment.**

EPO (Erythropoietin):

- Erythropoietin (EPO) is a hormone produced by the **kidneys** (90%) and **liver** (10%).



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- It promotes the formation of red blood cells by the bone marrow.
 - The biologic half life of EPO is **6 to 48 hours**.
 - EPO production may increase up to 1000 times in response to **hypoxic stress**.
 - EPO can increase **VO₂max** by a significant amount.

EPO Test:

- The patient is usually asked to fast for 10 -12 hours (overnight).
- The patient lies down quietly and relax for 20 - 30 minutes before the test.
- Normal levels of erythropoietin range from **4 - 24 mU/ml** (milliunits per milliliter) (**average 10 mU/ml**).

Synthetic EPO:

- Using **recombinant DNA technology**, erythropoietin has been synthetically produced for use as a treatment for persons with certain types of anemias, such as anemias from chronic kidney failure and dialysis:
- Epoetin alfa.
- Epoetin beta.
- Epoetin delta.
- Epoetin omega.
- Epoetin zeta.

Who Use Blood Doping?

Blood doping is used in endurance sports:

- Boxing.
- Biathlon.
- Cross country skiing.
- Cycling.
- Distance running.
- Horseracing.
- Mixed martial arts.
- Race walking.
- Triathlon.



Using **EPO hormone** is the most common type of **Blood Doping** among endurance athletes!



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Dangers of Blood Doping:

- 1) **Increased blood viscosity** which may cause headaches, chest pain, heart attack and stroke.
- 2) **Transfusion – induced diseases:**
 - Hepatitis.
 - HIV.



Soda Doping:

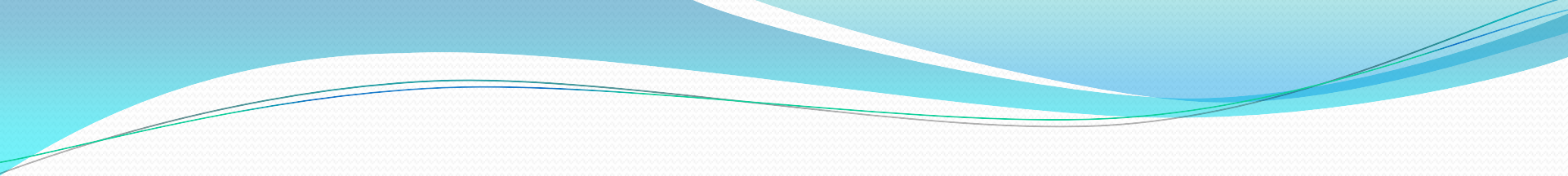
- It is manipulating the **pH level of the body** for the sole purpose of enhancing athletic performance.
- It is not in the list of WADA separately.
- It is a **subtype of blood doping**: Artificially enhancing the uptake, transport or delivery of oxygen.

- The name “**SODA**” originates from the name of **baking soda** (sodium bicarbonate).



Sodium Bicarbonate.

Image: Copyright©Depositphotos.com/Joaquin Vila

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- Soda doping in medicine is called “**Alkaline Diuresis**”.
 - Alkaline Diuresis is used in the management of acidosis and elimination of some medications (drug overdose) that make the body acidic.

Soda Doping

```
graph TD; A[Soda Doping] --> B[Increased pH Level]; B --> C[Decreased Production of Lactic Acid]; C --> D[Delayed Exhaustion  
Enhanced Oxygenation]; D --> E[Improved Performance];
```

Increased pH Level

**Decreased Production
of Lactic Acid**

**Delayed Exhaustion
Enhanced Oxygenation**

**Improved
Performance**

Procedure:

To make the body alkaline:

- You need a high doses of baking soda (**5 grams /kg**).

Alkaline Diuresis:

- A solution of **serum dextrose 5%, sodium bicarbonate, sodium chloride, and potassium chloride**.

Other Benefits of Sodium Bicarbonate:

- **Indigestion and heartburn.**
- **CPR (cardiopulmonary Resuscitation).**
- **Metabolic acidosis.**
- **Cancers.**

Consequences:

- Abdominal cramps.
- Diarrhea.
- Nausea and bloating.
- Severe allergic reactions (rash; hives; difficulty breathing; and tightness in the chest)

Para – Doping:

- **It is to drug someone intentionally to decrease his/her athletic performance or eliminate his/her from an athletic competition.**
- **It is uncommon in sports but may happen.**

Para – Doping



```
graph TD; A[Para – Doping] --> B[Inhibitory]; A --> C[Stimulatory]; B --> D[Indirect]; B --> E[Direct]; C --> F[Direct]; C --> G[Indirect];
```

Inhibitory

Stimulatory

Indirect

Direct

Direct

Indirect

Homework:

- 1) Describe how blood doping could improve athletic performance.
- 2) Describe para – doping.



