



EDUCATION SERIES ON DOPING CONTROL - 7

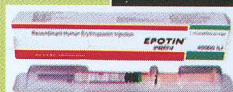
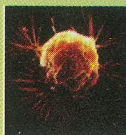


Detecting EPO use.

It is possible to distinguish recombinant EPO from endogenous EPO, and this can be done in both blood and urine samples.

Continuous erythropoietin receptor activator (CERA)

- Continuous erythropoietin receptor activator (CERA) : A longer lasting version of EPO is available for clinical use.
- Effective for longer, so patients (or athletes) need fewer injections and this is more convenient and cheaper. This molecule is EPO plus a large methoxy-polyethylene glycol polymer, doubling the molecular weight to 60kDa.
- Binds with low affinity to EPO receptor but not internalised, so keeps acting.
- CERA (EPO) could be used to replace other (EPO) drugs as Blood Doping agents in endurance sports, and as such fall under section S2 of "substances and methods prohibited at all times" (World Anti-Doping Agency, 20 September 2008).

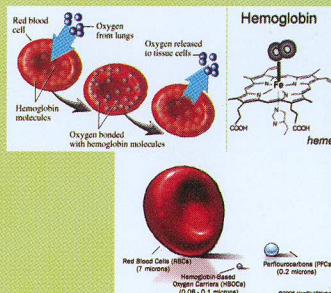


Haemoglobin based Oxygen Carriers (HBOCs)

- HBOCs are substitutes of blood prepared by crosslinking of Hemoglobin.

Clinical Use of HBOCs

- Shortage of stored blood (Surgery & Treatment)



TYPES OF HBOCs



CROSS AGENTS	LINKING	BRAND NAME
O-Raffinose		Hemolink
Diaspirin		Hemassist
Glutaraldehyde		Polyheme (Human Hb) Hempure (Bovine Hb)

CROSS AGENTS	LINKING	BRAND NAME
Glutaraldehyde		Oxyglobin (veterinary use)

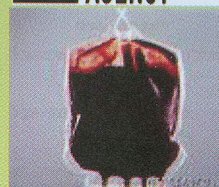


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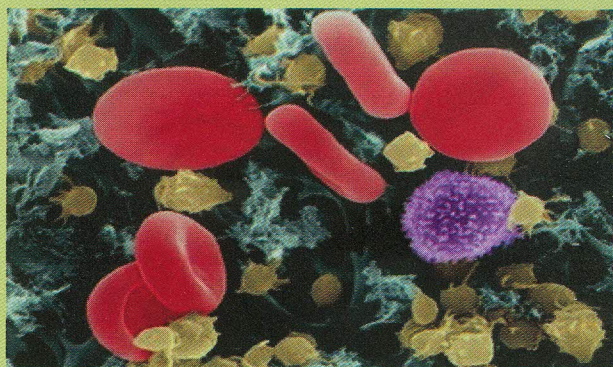
MISUSE OF HBOCs IN SPORTS

- Enhances oxygen uptake and transportation.
- Reduces lactic acid deposition.
- Improves overall performance.
- Prohibited by IOC in 2000 and WADA in 2004.



Blood Parameters:-

Monitoring the blood parameter of an individual and any altered / beyond range hematological parameter can reveal a blood manipulation



Athlete Biological Passport

In order to further improve detection of abnormal blood profiles, WADA is leading the development of a strategy against doping in sport called the Athlete Passport, which is based on following athlete's biological variables over time. The objective of this strategy, which will be added to other anti-doping strategies including "traditional" testing, is to detect abnormal variations of determined biological variables in order to better target testing and/or sanction those found with abnormal variations.

Conclusion

- Increasing blood haemoglobin levels increases aerobic exercise capacity significantly.
- Such effects are obtained with direct blood transfusions or with EPO injections.
- Both procedures are banned.

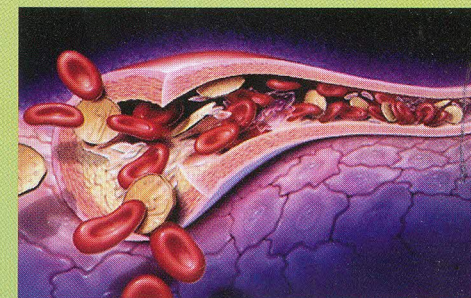


NATIONAL DOPE TESTING LABORATORY

(Ministry of Skill Development
Entrepreneurship Youth Affairs & Sports)
(A WADA accredited lab)
www.ndtlindia.com



Education Series on Doping Control-7 Blood Doping



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BLOOD DOPING

Competition is a natural part of human nature. Techniques and substances employed to enhance athletic performance and to achieve unfair success in sport have a long history. Among doping practices, blood doping has become an integral part of endurance sport disciplines over the past decade.

A test for EPO was introduced at the 2000 Summer Olympic Games in Sydney (Australia). The test, validated by the International Olympic Committee (IOC), was based on the blood and urine matrix. A blood screening was performed first, and a urine test was then used to confirm possible use of EPO. In June 2003, WADA's Executive Committee accepted the results of an independent report stating that urine tests alone can be used to detect the presence of recombinant EPO.

The delivery of oxygen to the muscles is of paramount importance in submaximal and maximal endurance exercise, and oxygen transport is a limiting factor in muscle cell work. The transfer of oxygen to working muscles is a function of the muscle blood flow and the oxygen content of the blood.



Oxygen is delivered in two ways: either diffused in plasma (3%) or linked to Hb (haemoglobin) (97%).

WHAT IS BLOOD DOPING ?

Blood doping is the procedure of increasing the amount of red blood cells in the human body to create better all round performance. By increasing the number of red blood cells in the body, there is more oxygen supply to the muscles and hence, increasing an athletes aerobic capacity and endurance.



The basic idea behind blood doping is to raise the oxygen carrying capacity of blood and to improve performance in events involving aerobic exercise i.e. any event lasting more than 1 – 2 minutes.

This can be done by either

- By legal means (altitude training) or
- By illegal means blood doping or "boosting" by use of the hormone erythropoietin, Blood Transfusion , HBOCS etc".

BLOOD DOPING TECHNIQUES

- a) Blood transfusion
 - 1) Autologous blood transfusion
 - 2) Allogeneic blood transfusion
- b) Erythropoiesis-stimulating substances
 - 1) Recombinant human erythropoietin (rHuEpo)
 - i) Epoetin alfa (Epogen[®], Epres[®], Eporitin[®], E-Globurein[®], Procrit[®])
 - ii) Epoetin beta (Eporin[®], Marogen[®], NeoRecon[®])
 - iii) Epoetin gamma
 - iv) Epoetin delta (Dynepo[™])
 - 2) Darbepoetin alfa, a novel erythropoiesis-stimulating protein or NESP (Aranesp[®])
 - 3) Continuous erythropoiesis receptor activator
- c) Hypoxic training
 - 1) Artificial altitude environments or facilities
 - 2) Hypoxic gas mixtures
 - 3) Supplemental oxygen breathing
- d) Blood substitutes
 - 1) Perfluorocarbon emulsions
 - 2) Hemoglobin-based oxygen carriers
 - 3) Allosteric modulators of hemoglobin
- e) Supplementation therapies
 - 1) Iron
 - 2) Cobalt chloride
- f) Gene doping
 - 1) Human erythropoietin gene transfection
 - 2) Regulation of the HIF pathway



Blood doping is used in all types of endurance events such as long distance running, cycling, cross country skiing, long swimming events and so on.

Blood Transfusion

Blood Transfusion is infusion of blood that significantly improves physical performances due to increased red blood cells and therefore oxygen transport capacity to muscles

What is the difference between heterologous and homologous Blood doping?

- Homologous allogenic – where the blood donor and transfusion recipient are different and blood group is same
- Heterologous or Autologous – where the blood donor and transfusion recipient are the same.



Side Effects of Blood Transfusion

- Homologous transfusion
 - Great care needs to be taken over tissue/ antigen matching.
 - There is the risk of getting a blood-borne infection such as AIDS or hepatitis.

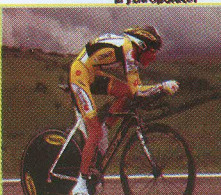
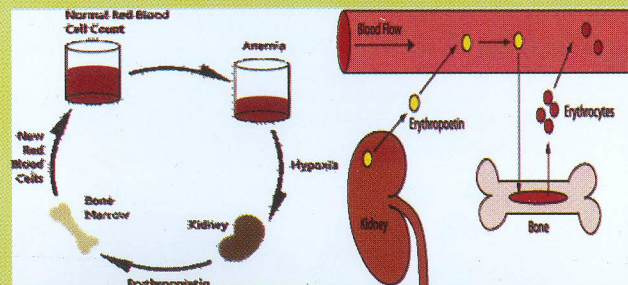
Autologous transfusion

- Means long periods out of competition as it takes 4-6 weeks to recover from a blood donor session

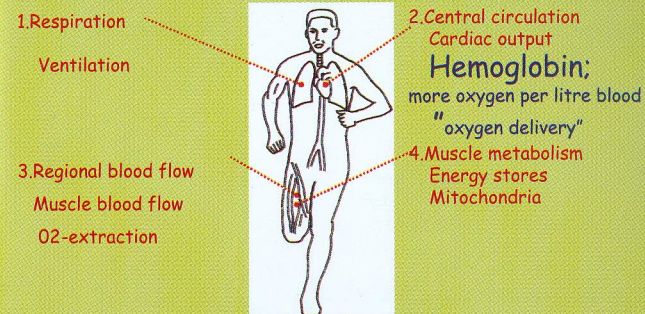
For both methods the effects begin to wane within 3-4 weeks, so then need a repeat transfusion.

What is Erythropoietin (EPO) and why is it used?

- EPO is a protein hormone produced by the kidney in response to tissue hypoxia. After being released into the blood stream it binds with receptors in the bone marrow, where it stimulates the production of red blood cells.

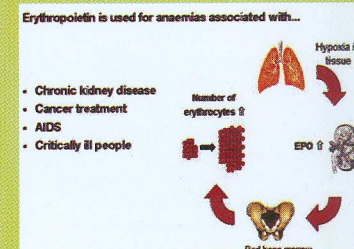


EPO stimulates the production of red blood cells and thus the hemoglobin level



In the 1990s synthetic (recombinant)EPO became available !

Medical uses of EPO



Effect of Erythropoietin (EPO)

- Reduction in O₂ pressure, increases in red cell production 6-9 times by stimulating EPO secretion.
- It is possible to stimulate benefit of altitude training upon secretion of EPO by administration Of synthetic or human EPO.
- Administration of EPO has effect on aerobic performance of endurance athlete. It Increased RBC, hemoglobin, haematocrit and reticulocyte count.
- Serious risks:- Magnitude of increased RBC production can not be accurately assessed and haematocrit may be raised to high levels.

ROLE OF EPO IN SPORTS

Recombinant EPO (rEPO) is used specifically by endurance athletes to increase aerobic endurance with effects similar to that of blood doping (Blood transfusion).

Side-Effects of Erythropoietin

- There are major side-effects of using erythropoietin which have proven to be fatal in VARIOUS cases:
- Increased viscosity (thickness) of the blood (which increases the risk of heart attack and stroke)
- Fever
- Seizures (fits)
- Nausea
- Headache
- Anxiety
- Lethargy