
Erythropoietin Abuse in Sport: A Health Hazard Approach

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Abstract: In endurance domain sports disciplines the role the supply of oxygen to muscles plays a significant role. Indeed, muscle performance declines during prolonged and intense activity as a consequence of the shift from the aerobic to the anaerobic metabolism with an increase of lactate. To enhance the aerobic capacity two alternatives may be used: increasing either the transport or the delivery of oxygen. In this setting, erythropoietin use is the practice of illicitly using a drug to improve athletic performances. In the present overview, old and newer erythropoietin stimulating molecules are described with a special emphasis on their potential side effects. Direct and indirect detection methods are briefly described with the aim of mentioning their roles and limits with regard to anti-doping strategies. The purpose of this review is to consider EPO abuse in sport, health hazards and risks of use of EPO by athletes. Analytical methods was used for this paper by reviewing relevant publications, primarily based on the online sports medicine journals available on Internet, Wikipedia, Elsevier, PubMed and National Anti-Doping Agency literature.

Keywords: *Erythropoietin, Sport, Side effects.*

Introduction

Erythropoietin (EPO) hormone increases the count of red blood cells in the blood. EPO are used by athletes to perform better in endurance events. Because of EPO the viscosity of blood increases which add to the risk of blood clotting and may lead to a stroke. The most recent means of artificially boosting RBC counts involves a drug that has been the target of accusation and speculation among the professional cycling world for more than a decade. Erythropoietin (EPO) is a naturally-occurring hormone, produced by the kidneys, that stimulates the production of red blood cells. This hormone can also be manufactured and injected into the skin or directly into the blood stream. EPO may be used in medical practice to bring patient's RBC into normal levels. The use of artificial EPO as a means of increasing athletic performance first showed up 1980s and has recently been linked with drug-use claim that EPO doping is still widespread in pro sports. In 2012 disgraced U.S. cyclist Lance

Armstrong has been personally urged to make a full confession of all his involvement in doping by the founder of the lobby group Change Cycling Now. Erythropoiesis is part of a large process of haematopoiesis that involves the production of mature cells found in the blood and lymphoid organs. Haematopoiesis is continuously required because of normal turnover in cell populations of blood and lymphoid organs. In the normal adult human, the daily turnover of erythrocytes exceeds 10¹¹ cells. In periods of increased erythrocyte loss due to haemolysis or hemorrhage, the production of erythrocytes increases rapidly and markedly. However, an overproduction of erythrocytes does not occur even after the most severe loss of erythrocytes. In haematopoiesis, a few rare hematopoietic stem cells in the bone marrow reproduce and differentiate to give rise to all the cellular components of the blood and the lymphoid system. During this process, an individual hematopoietic cell undergoes an apparent random process called commitment. When a cell undergoes commitment, its proliferation becomes limited and its potential to develop into multiple types of mature cells is restricted. Thus, these hematopoietic cells are referred to as committed, lineage-specific progenitor cells.

The major stages of differentiation in mammalian erythropoiesis are:

- The most immature stage of committed erythroid progenitors is the burst-forming unit-erythroid (BFU-E).
- The next major stage of erythroid progenitor cell development is the colony-forming unit-erythroid (CFU-E).
- A continuum of erythroid progenitor stages exists between the BFU-E and CFU-E, with decreasing proliferative potential as the progenitors approach the CFU-E stage.
- The descendant cells of the CFU-E are termed erythroid precursor cells.

The erythroid precursors are proerythroblasts, basophilic erythroblasts, polychromatophilic erythroblasts and orthochromatic erythroblasts. The orthochromatic erythroblasts do not divide but they enucleate, forming of immature red blood cells, the called the reticulocyte.

Methods:

This survey is an analysis of literature on of up to now research conducted on Erythropoietin in sports medicine. The analysis involves a dozen scientific databases, examined in order to find out the health hazard approach in sports. The gathered data are supplemented and verified from the web source of WADA, NADA and NDTL.

Mechanism of Erythropoietin Action- As far as athletes are concerned, use of synthetic

EPO offers a means to increase arterial/blood oxygen content, which in turn leads to an increase in maximal oxygen uptake. Endurance sports such as swimming, running, rowing and cycling stand to benefit most from an increase in maximal oxygen uptake as this is one of the limiting factors for performance. An additional benefit of EPO use is once administration is discontinued, red blood cells only return to their original levels very slowly, i.e. about a month. This effectively means an “open window” may exist where there is no evidence of EPO misuse but where performance is still enhanced. Furthermore, the enhanced red blood cell mass may allow the athlete to sustain a greater training stimulus, which could produce a subsequent improvement in performance potentially quite remote in time from when there is evidence of EPO misuse.

Misuse in Sports:

There are two type of EPO used in sports these are natural and synthetic, both EPO are proteins made up of the same sequence of basic elements, the amino acids. However EPO carries on its surface specific polysaccharide chains, which are slightly different in the natural and the synthetic versions of the hormone.

Endurance athletes use EPO to increase their oxygen supply by as much as 07 to 10 percent. But the main side effect is that increased red blood cell density caused by EPO thickens the blood, and thickened blood which is more like honey than water does not flow through the blood vessels well. To pump the thickened blood, the heart must work harder, and this increases the chances of heart attack and stroke.

There were rumors of EPO misuse in sports already shortly after the first erythropoietin produced by genetic engineering was brought to public. By raising the number of red blood cells, the blood can transport more oxygen and in this way better supply the muscles. Similar effects are achieved through blood doping, a more elaborate and hazardous technique.

- **Health Hazard Effects-** ESA drugs aim to boost red blood cells and improve energy. In medical science they use to prevent unnecessary blood transfusions that carry their own risks as patients await possible kidney transplantation. But recent studies linked higher doses to strokes, heart attacks or even death.
- **Risks of erythropoietin use:** The risks of anemia drugs known as erythropoiesis-stimulating agents, or ESAs are many. Studies show that the user with breast or advanced cervical cancers who receive erythropoiesis-stimulating agents to boost the performance died sooner or have more prone to cancer tumor than similar the person who don't use these drugs.

- **Increased HDL Cholesterol level:** Long-term use of erythropoietin increases serum HDL- cholesterol levels in users with chronic kidney disease and decreases serum LDL- cholesterol.

Worsens the kidney Problem:

- **Increased death rate with high doses in kidney patients:** Use of controversial anemia drugs at high levels likely worsens heart problems and possibly chances for survival in kidney patients, Achieving higher target hemoglobin levels with erythropoietic agents in patients with renal insufficiency is associated with a significantly higher risk of serious and life-threatening cardiovascular complications.
- **Erythropoietin and hepatitis:** Treatment with erythropoietin worsens thrombocytopenia induced by pegylated-interferon-alpha therapy in patients with chronic hepatitis C infection.
- **Erythropoietin adverse effects and caution:** Despite some potential adverse effects, such as hypertension, and the occurrence of erythropoietin resistance, early studies in mild heart failure patients with anemia suggest that erythropoietin therapy is effective in reducing left ventricular hypertrophy, enhancing exercise performance and increasing ejection fraction.

Conclusion:

We can conclude that Erythropoietin increase the level of hemoglobin has been proven to boost VO₂-max. This improvement may result in a prolonged time to fatigue at ninety five percent VO₂max, as well as in a lower contribution of anaerobic metabolism to energy production. The immediate and long-term adverse effects should be strongly emphasized, considering that they may occur in young and otherwise healthy subjects. Documented side effects of erythropoietin use include muscle cramps, upper respiratory infections, headache, hyper viscosity, thrombosis, and hypertension, long-term use of erythropoietin use can also lead to the development of pure red cell aplasia (PRCA), which occurs from the generation of antibodies against Erythropoietin use that are able to neutralize native Erythropoietin, leading to the absence of red cell precursors in the bone marrow. The development of PRCA with chronic kidney disease receiving erythropoietin use seems to be associated with use of erythropoietin. There are major side-effects of using erythropoietin which have proven to be fatal in previous cases: Increased viscosity of the blood increases the risk of heart attack and stroke, fever, seizures, nausea, headache, anxiety, legerity.

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