

## The Strong Evidence between Oxidative Stress and Sports

Prof. Dr. Marcel Capt

*Doing sports is not only fun – a continuously moderate physical exercise plays an important role in physical condition and health. It is well accepted that sport has a preventive effect against **diseases like diabetes, arthrosis, osteoporosis and cardiovascular disease**. In a study performed by Vasankari et al. in 2008 with 104 test persons doing none or very little sports could be shown, that the number of Low-density-lipoproteins (LDL) after a 10-months training program (cycling, jogging, working in the garden, hiking or dancing) decreases significantly. Low-density-lipoprotein are one of the major risk factors for atherosclerosis.*

On the other hand, in numerous other studies it was shown that high impact sports or exercises result in a notable oxidative stress situation coming along with an elevated concentration of ROS or general reactive oxygen species with toxic effects. There has been various mechanism identified:

- Elevated oxygen consumption during exercises
- Hyperthermia of muscles
- Spontaneous oxidation of catecholamine
- Spontaneous oxidation of lactic acid
- Elevated turnover of ubiquinone 10
- Local ischemia
- Intestinal reperfusion
- Micro inflammations because of strong leucocyte activation

**As a consequence of high oxidative stress numerous symptoms can be seen by athletes doing competitive or endurance sports. Which could be:**

- Muscle damages
- Fatigue
- Asthenia
- Cramps
- Delayed reconstitution time

In addition, the studies revealed that oxidative stress generated by high impact sports like marathon or half distance marathon, cycle race, jogging, treadmills, triathlon, cross-country skiing, long distance swimming, 5.000m or 10.000m runs or team sports like soccer, handball, basketball or ice hockey also lead to oxidative damages in:

- Lipid structure
- DNA structure
- Changes in plasma concentration of anti-oxidants
- Changes in the redox system, especially in the glutathione redox system

The results of a study performed by Pincemail et al. in 2000 showed very high antibody titers against oxidized LDL.

Intensive physical exercises result very often in an elevated concentration of anti-oxidative enzymes like:

- Superoxide Dismutase (SOD)
- Catalase
- Glutathione Peroxidase (GPx)
- Heme Oxygenase (HO-1)

At the beginning of an intensive training an elevated concentration of GPx or SOD in blood was measured in some athletes (specially cyclists). Compared to the values in persons doing moderate sports they have been higher. The reason an adaption process trying to balance the oxidative stress situation. At first sight this might look positive but has a negative effect long term on the protecting resources. The resources have to be replenished permanently; this is why it is recommended for athletes doing competitive sports to support the metabolism by intake of minerals, vitamins and trace minerals.

Also, people doing sports in their leisure time on an intensive basis should rebalance the oxidative stress misbalance by intake minerals, vitamins and trace minerals.

But it is important that the treatments are not started by following word-of-mouth or any other general recommendations. The best treatment is based on the individual results of a spectrophotometric measurement that enlightens the current situation in the cells and not in blood. Blood values are not stable and cannot be regarded as representative.

At his point, we want to cite what Prof. Dr. Ferret, responsible medicine for the French national soccer team and Olympique Lyon, has said in an interview:

*The food supplementation of the soccer player is based on tests and analysis which are performed three times a year, which means every four months, to see the balance between the free radicals and the antioxidants.*

### **Deficiencies in professional soccer player**

During the European Soccer Championship and other international championships 2000/2001 more than 50 percent of the active soccer player exhibited deficiencies that required fixing. Although a lot of players had been identified to have deficiencies, individual differences were observed. According to Prof. Dr. Ferret some individuals had a higher compensating potential on oxidative stress phenomenon than others. Maybe, and this has to be pointed out quite clearly, because they spend more attention on nutrition which was maybe more organic and rich in anti-oxidants. Although reported very often not all had understood the meaning of nutrition on health and productive potentials.

Athletes having a good protecting anti-oxidative capacity do not need necessarily additional anti-oxidative food supplements, besides in intensive training sessions. Intensive physical exercises increase the oxygen turn over especially in skeletal muscles and heart.

Even in well-trained skeletal muscles long term high impact exercises force the anti-oxidative protection up to its limit and cause an oxidative stress situation. The reactive ROS attack the unsaturated fatty acids in the cell membranes and start a lipid peroxidation cascade. Oral antioxidants like vitamin E and C, in combination with beta-carotene, selenium, magnesium or glutathione can reduce the lipid peroxidation process during and after exercises. A spectrophotometrically measurement will help to identify the deficiencies and allows a precise treatment.

### **Measurements of oxidative stress**

Only three years ago oxidative stress could only be measured indirectly, mostly by blood measurements. To determine oxidative stress oxidized by-products of the lipid peroxidation cascade like malondialdehyde (MDA), conjugated diene or isoprostane were measured in whole blood. Markers for oxidized proteins were thiols in plasma, carbonyl compounds or nitro tyrosine. 8-oxo guanosine or other bases are generated from oxidized DNA or mutations in DNA structure. Even in the exhaled air markers like ethane or pentane were measured.

There are many reasons why we do not turn our main attention on blood measurements. Blood measurement results are not reliable, difficult from an analytical point of view and do have some disadvantages like:

- Advanced technological systems necessary
- Close cooperation with specialized laboratories
- Delicate handling of the samples to prevent oxidation after sample taking
- Rapid processing of samples for reliable results

- Precise handling of samples for reliable results e.g. temperature controlled centrifuging

Reliability of results depends strongly on standardized sample processing.

### **EDEL Method**

Some years ago, another method was used, that has lost its meaning up today. It was the so-called EDEL-method working with capillary blood. The results were available within 10 minutes. The results showed the anti-oxidative defending capacity by ascorbic acid (vitamin C) interaction.

No other antioxidants were taken into consideration. And the result can be influenced by additional vitamin C intake by the investigated persons. No information about the oxidative stress situation was stated.

### **Form plus with Ford-Test method**

An Italian device is on the market since several years, the Form plus having the Ford-test on-board, measuring albumin, Trolox, -SH-groups. A second test method on the device, the Ford method is evaluating the ROOH hydro peroxides.

Disadvantages of the method: A system run takes quite a long time – 30 minutes – and the reagents for the tests have a short shelf life. The method needs an invasive capillary blood taking and is rather expensive. This is why acceptance and placements of the system are poor.

### **Spectrophotometrically Test method – Zell-Check**

For the moment being there is only one method on the market that is measuring reliably the oxidative stress load and the anti-oxidative capacity. The method based on a spectrophotometrically technology using a bio photonic resonance scanner is called **Zell-Check**. The system is during its online mode connected to the server of the medico-scientific center in France and is delivering its results within 1 minute.

The measurements are performed with the scanner unit placed on distinct spots on the hand palm. The results reflect the situation on the cellular level and not within the intercellular liquids. Measurements within the liquid fractions are less stable and reliable.

Our hands are well vasculated extremities and are reflecting the whole-body metabolism. The epithel cells in the hand palm represent the physical all over resource situation and is therefore ideal for spectrophotometric measurements. Abnormalities or misbalances could be identified within the tissue fractions months before they show up in the blood.

The spectrophotometric technology, awarded with the Nobel prize, is not new per se but it is very innovative in preventive medicine.

The principle: The spectrophotometry allows a quantitative analysis where the absorbance or optical density of chemical components are measured. Every chemical component has a light absorbance, emission or reflection at a distinct wave length. Light absorption is depending on the quantity of a component; the higher the concentration the more light is absorbed. According to the Lambert-Beer law absorption is proportional to the concentration of a component.

**The Zell-Check technology based on the Lambert-Beer law is an innovative and non-invasive method delivering results within a very short time and is very cost-efficient.**

What is important: the Zell-Check measurements are recommended to be repeated within the competition season specially for endurance or team sports like soccer, ice hockey, basketball, rugby, cycling etc. once a month. This monitoring provides long term data to optimize sports results.

During competition when athletes are performing at their physical limits and the metabolic turnover is high, the oxidative stress parameters are going up. This is normal but may vary significantly in different individuals. Summarized it should be accepted that the concentration of minerals and/or trace minerals will be measured lower at the end of the competition seasons. This is the case for the majority e.g. potassium, iron or iodine but mainly seen for antioxidants, magnesium and selenium.

Another point that has to be discussed is the concentration of heavy metals in metabolic key areas. The risk of heavy metal poisoning is still there because of the permanent release of heavy metals from industrial resources into the biological circles. A spectrophotometric measurement allows in a very short time to

discover any heavy metals in the body. It is well known that heavy metals bear a significant risk for human health and well-being and do have an impact on the physical performance e.g. in competitions. Detoxification is therefore important. But detoxification takes time and is going along with a loss of minerals. Detoxification therefore should be monitored and the mineral stocks have to be replenished.

#### **Summary**

Every athlete, trainer, coach or doctor should be informed about the negative impact on physical performance and capacity of oxidative stress and the options for rapid regeneration and optimization of physis.



#### **About the author**

Prof. Dr. Marcel Capt, formerly a surgeon, has already dealt with the effects of oxidative stress 15 years ago. Since then, he has specialized in orthomolecular and anti-aging medicine. He has been leading a center for preventive and anti-aging medicine for three years at Cinic Lémanic in Lausanne (Switzerland). He writes as a member of the International Scientific Press for several medical journals and gives lectures at numerous congresses, such as the AWMC in Monaco.