Closer Scrutiny by Doping Detectives: Summary Points on the Athlete Biological Passport

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While enjoying the plethora of top-class sporting events and broadcasts nowadays and admiring the phenomenal lengths to which athletes stretch human performance in such a variety of activities, one unfortunately still cannot escape the odd half-whispered comment or vociferous accusation of doping by some athletes. The arms race between dopers and doping control occasionally enjoys publicity rivalling that of events themselves, certainly amongst the sport science and medicine community, and notably in some sports.

In 2008 the Athlete Biological Passport (ABP) was introduced amidst claims ranging from it being prohibitively costly and overly invasive to a promising development and even a breakthrough process to end doping in sport. In some sports, the impact was clear almost immediately, with significant drops in the number of abnormal test results in cycling, for example. This short summary of points hopes to provide an overview of the fundamental aspects of the ABP – what it is, its benefits and its limitations. Feel free to consult the referenced reading or contact me for more detailed debate.

1. The ABP attempts to identify suspicious results in biological markers that cannot be caused or explained by means other than doping. These markers are most commonly constituents of the haematological (blood) system but may also include the endocrine (hormone) and other body systems.

2. When the focus is on anti-doping procedures to tackle ways of improving endurance capacity through changing the oxygen carrying capacity of the blood, the main blood parameters measured in the ABP are reticulocytes and haemoglobin.

3. Manipulating the oxygen carrying capacity of the blood (commonly known as blood doping or blood boosting) is done through two main methods, either removing and re-infusing red blood cells (RBC's) or using EPO to stimulate greater rates of RBC production.

4. Reticulocytes are immature RBC's, the ones that have most recently been produced by our body and have entered the circulation, but don't yet have the same characteristics as the mature RBC's. Since we make (and break) RBC's continuously, we always have some reticulocytes in our blood (around 1%). Being the precursors to mature RBC's you will appreciate that as RBC production is speeded up, the reticulocyte numbers increase first.

5. Haemoglobin (Hb) is a protein molecule inside RBC's and is the main transporter of oxygen in the blood. Since the vast majority of Hb is found in the billions of mature RBC's we have in our blood, any changes to the number of RBC's is reflected as a change in the concentration of Hb.

6. Reticulocytes usually make up between 0.5% and 1.5% of the RBC population, but the concentration can lie outside this range. Likewise, Hb concentration (in males, for example) is typically 140-160 g per litre of whole blood but may be higher or lower in some individuals. Because of these normal individual variations, rather than measuring the absolute concentration at any point in time, regular measurement of any changes in the concentration over periods of time is the premise on which the ABP works.

7. For example, when whole blood is withdrawn the concentration (%) of reticulocytes generally rises since the vast majority of cells removed are mature RBC's, and because the production of new RBC's continues and is stimulated by the removal, but there are fewer RBC's in total. Conversely, the re-infusion of stored blood causes a drop in reticulocyte concentration (%) because almost all of the newly infused cells are mature

RBC's, so one's own immature RBC's represent a smaller percentage of the new, larger RBC population.

8. The opposite is true for Hb. The withdrawal of whole blood is characterized by a fall in Hb concentration while the re-infusion of blood increases Hb levels owing to mature RBC's being the major site of Hb in the blood.

9. These two variables provide the convenient flags to measure. They are used to calculate an Off-Score or Stimulation Index, a ratio of Hb to reticulocytes. The Off-Score is able to detect withdrawal of blood (characterized by a rise in reticulocytes and a fall in Hb) and the re-infusion of blood (reticulocytes fall and Hb concentration rises). EPO use (stimulated RBC production and thus increased reticulocyte concentration) can also be detected by monitoring these two variables.

10. As is the case with reticulocytes and Hb, there is a 'normal' range in Off-Scores, but because of differences between individuals, natural variation and probabilities, it's not good enough just to set an upper limit and use it to ban athletes. If the ABP results are designed to ban dopers, one needs to be very sure that those measured values and Off-Scores do not occur in an un-doped athlete. The result of this is that anti-doping authorities put stringent scientific standards in place to deal with athletes whose Off-Scores may be outside of the normal range.

11. These include establishing statistical confidence limits for the test parameters that are very difficult to fall above/below in the absence of any doping, and continuing to research and monitor these and other parameters in athletes to better learn about what normal variations are, or said differently, what changes are truly reflective of doping behaviour. Several studies have already been completed in which important blood, hormone and other biological markers are tracked in un-doped and doped athletes over periods of normal training, diet, travel and health fluctuations.

12. When an athlete is identified as having test results that have changed in a manner suggesting doping, a panel of scientists considers the data and explanations before deciding on procedures against the athlete. This allows protection of innocent athletes in the small but possible scenarios of pathologies causing abnormal conditions or random false positives.

13. One disadvantage of the ABP is that setting very high confidence levels means that there will always be the risk of not identifying some athletes who have doped but don't reach the flagging criteria. However, this is not the same as saying that doping behaviour is not be curbed.

14. One advantage of the ABP is that the physiological changes associated with doping can be detected without needing to identify a drug. After all, if doping is effective in enhancing performance then some biological parameter(s) must be altered over their normal, un-doped values. It may well be simpler to monitor these for unusual fluctuations than to test for the host of pharmaceutical agents being developed.

As with all anti-doping test procedures, absence of positive test results does not prove the absence of doping practices. As long as winning at the highest level in sport remains highly valued, very difficult and distinguished by incredibly small values, the intentional and systematic attempt to use prohibited substances or methods will be around, and some athletes will make use of them. However, the ABP represents a significant change in anti-doping mindset towards using longitudinal, individual monitoring of practical biological markers against a background of physiological understanding to detect planned doping in the absence of drug or equipment evidence. The data to date suggest that a measurable impact on behaviour has already taken place, and if the real goal of anti-doping policy is to discourage doping, then the ABP must be seen as effective in the fight.

References

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