

### Adjustments to Stress

- When stress is identified, both the endocrine and nervous systems make adjustments to enable the body to cope (see Fig.1, p.388)
- The nervous system rapidly adjusts breathing and blood flow
- The endocrine system provides a slower but more sustained response
  
- Stress hormones provide more blood glucose to cope with the elevated energy requirements brought on by stress
- Insulin has to be inhibited, or else the additional blood glucose would trigger a release of insulin, lowering blood glucose
  
- The nervous system activates the rennin-angiotensin-aldosterone pathway in response to reduced blood flow to the kidneys
- By increasing Na<sup>+</sup> reabsorption, the kidneys help maintain increased fluid volume, sustaining adequate blood pressure during stress
- The stressor also activates the hypothalamus, releasing more ADH, further increasing water reabsorption from the nephron
- During sports, the accelerated cardiovascular activity provides more O<sub>2</sub> delivery to the tissues for increased cellular respiration
- Increases in blood sugar and fatty acid levels provide more fuel
- More ATP produced
  
- It is more difficult to adjust to emotional or psychological stress, because the increased energy supply is not always used
- Increased nerve activity does require more energy, but there is usually more ATP produced than needed
- Prolonged exposure to high blood glucose, high BP and an elevated metabolic rate often causes the adjustment of control systems to permit the higher operating rate (see Table 2, p.389)

### Prostaglandins

- Local responses to changes in the immediate environment of cells are detected by mediator cells, which produce prostaglandins
- Prostaglandins are secreted in low concentrations by mediator cells, but secretions increase when changes take place
- Stimulated by epinephrine, prostaglandins increase blood flow to local tissues (for repair)
- Other prostaglandins trigger the relaxation in muscles leading to the lungs
- Prostaglandins are also released during allergic reactions

### Chemically Enhanced Sports Performance

- A variety of different drugs can cause the body to respond as if hormone levels have increased (ex/caffeine mirrors the effects of epinephrine)
- Anabolic steroids are designed to mimic the muscle building traits of the sex hormone testosterone

- Specifically, anabolic steroids increase lean muscle development and enhance strength (good for weightlifting and sprinting)
  - They would be detrimental to athletes competing in more aerobic sports or sports of agility (like marathon runners or cyclists)
  - There are many health risks, including the fusion of growth plates
  - Some other side effects: acne, growth of facial hair (women), development of breasts (men), liver disease, infertility (see Fig.2, p. 391)
  - Psychological effects include mood swings and rage
  - To avoid testing positive for anabolic steroids, male athletes may supplement with esters of testosterone, which prevent the metabolism of naturally occurring testosterone, keeping it active longer
  - Because these esters are naturally occurring, they are difficult to detect
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- Sharpshooters and archers have used beta blockers to slow the heart rate, allowing them to better aim
  - Endurance athletes have been caught taking EPO (erythropoietin) which increases production of RBCs, allowing them to carry more  $O_2$
  - Growth hormone decreases fat mass and promotes protein synthesis for muscle development
  - Because the body naturally produces GH and EPO, they are difficult to test and more sophisticated methods must be developed
  - For more info on these and other banned performance-enhancing drugs, see Table 3, p. 391

### Homework

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