FINAL EXAM KEY

NROSCI/BIOSC 1070 and MSNBIO 2070
FINAL EXAM
December 10, 2013

Total POINTS: 100 20% of grade in class

1) During abdominal surgery, both vagus nerves are cut just below the diaphragm. Please answer the following questions about how loss of vagal innervation of the abdominal organs affects digestion.

a) Would loss of vagal innervation of the stomach affect the secretion of acid into the stomach lumen? Is so, indicate how stomach acid secretion would be altered. If not, indicate why there is no change in stomach acid secretion. ***(5 points).***

The cephalic phase of acid secretion would be missing. There would be little acid in the stomach until after the meal was consumed. This would delay the breakdown of protein. However, since the cephalic phase results in only a fraction of stomach acid secretion, there would not be a major impact on protein digestion.

b) Would loss of vagal innervation of the pancreas affect the secretion of insulin? Is so, indicate how insulin secretion would be altered. If not, indicate why there is no change in insulin secretion. ***(5 points).***

The cephalic phase of insulin secretion would be missing.

2) Control of digestion is much more dependent on hormonal secretion than many other physiological processes. Why would it be impossible to effectively regulate digestion using only neural mechanisms? Provide a brief explanation for your answer. ***(10 points).***

Digestion must be adjusted depending on the nutrients present in the food consumed. For example, there is a need for a large release of bile from the gall bladder following a fatty meal, but not following a carbohydrate meal. There is a need for insulin release following a carbohydrate meal, but not a fatty meal. Consequently, hormones are released from the GI tract in accordance with the nutrients present. These nutrients can only be detected after the food is at least partially digested into its fundamental components.

3) Aspirin and Tylenol have approximately the same efficacy in reducing fever. However, aspirin is sometimes prescribed to patients at risk of a heart attack, whereas Tylenol is not. Explain why aspirin, but not Tylenol, can reduce cardiovascular risk in patients. ***(5 points).***

Both Aspirin and Tylenol are equally effective as Cox-2 inhibitors. However, Aspirin also inhibits Cox-1, and does so much more effectively than Tylenol. Cox-1 is responsible for synthesis of prostaglandins that promote platelet aggregation, which can result in blood clots that block coronary blood vessels.

4) When part of the intestine is removed surgically (intestinal resection), motility in the intestine ceases for a period of several days. This condition is called "physiologic ileus". Why does physiologic ileus occur postoperatively after removal of a portion of the colon? ***(5 points).***

Colon surgery damages the enteric nervous system, which results in the loss of motility. Motility returns after neurons in the remaining enteric nervous system make synaptic connections.

5) Synthetic human growth hormone (HGH) was developed in 1985 and approved by the FDA for specific uses in children and adults. Unfortunately, some individuals illegally gain access to HGH, and use it for unapproved purposes. One such use is as a "performance enhancer" in adult athletes, despite the fact there is no good evidence that the drug aids athletes. Common complaints of adults who abuse HGH are joint pain and carpal tunnel syndrome (which occurs when the median nerve, which innervates the hand, is squeezed in the wrist. Why would misuse of HGH in adults result in these complaints? ***(5 points).***

Growth hormone stimulates growth of soft tissues (cartilage) in adults, whose bones can no longer lengthen. Overproduction of soft tissue in joints results in joint pain, and loss of function if nerves are compressed by the mass of soft tissue.

6) An athlete seeks to illegally obtain anabolic steroids, but mistakenly obtains another type of steroids: glucocorticoids. Would taking large doses of glucocorticoids for a month improve or worsen the athlete's performance? Provide a brief explanation for your answer. ***(5 points).***

Glucocorticoids stimulate gluconeogenesis, and thus cause muscle breakdown. This would make performance worse!

7) A standard thyroid test battery includes an assay for blood levels of both TSH and thyroid hormone. A patient is identified with abnormally high levels of both hormones. What is the most likely cause of this medical condition? Provide a brief justification for your answer. ***(5 points).***

A TSH secreting tumor would cause these effects. High levels of TSH would cause high levels of thyroid hormone. However, the tumor would not respond to feedback inhibition.

8) Two men with a height of 6 feet have a body mass of 210 lb. One of the men is lean and muscular, and the other is obese. Which of the men has a higher basal metabolic rate? What is the physiological reason for the higher basal metabolic rate in that individual? ***(5 points).***

The lean, muscular man has a higher basal metabolic rate. Muscle tissue requires more ATP per unit mass than adipose tissue to perform routine metabolic functions.

9) An unscrupulous physician is approached by a normal-weight individual who wants to lose weight quickly to obtain a job as a fashion model. The physician injects the patient with insulin to suppress appetite. However, this treatment results in the patient becoming comatose.

a) Why did insulin injections in this individual result in coma? ***(5 points).***

Insulin injections resulted in most of the glucose in the body being imported into liver, muscle, and adipose tissue. As a result, blood glucose levels dropped very low. Since the central nervous system needs glucose for metabolic activity, brain metabolism was suppressed, resulting in coma.

b) If insulin was prescribed orally (i.e., as a pill or capsule), would it have had the same effect on the individual? Provide a brief rationale for your answer. ***(5 points).***

There would be no effect whatsoever on the individual. Insulin must remain intact as a large protein to be effective. Large proteins cannot be absorbed into the bloodstream through the GI system. Insulin would be broken down into amino acids in the GI tract.

10) Boniva® *(ibandronate sodium)* is a member of a class of drugs called bisphosphonates***.*** Boniva® was approved by the FDA in 2003 to treat women with osteoporosis. Describe Boniva's mechanism of action that makes it an effective treatment for osteoporosis. ***(5 points).***

Boniva (ibandronate sodium) is a bisphosphonate that inhibits osteoclast-mediated bone resorption. In osteoporosis, where osteoclasts break down bone too quickly, inhibition of this pathway has been shown to slow bone turnover, leading to not only an attenuation of turnover but also a mean increase in bone mass.

11) Activating mutations in the luteinizing hormone receptor (LHR) gene are one of the most common mutations found in the gonadotropin receptor genes. The LH receptor is active from birth in individuals with this condition, as though high levels of LH were always present. The following questions relate to individuals with this condition.

a) What physiological differences would be noted in an 8 year-old boy with an activating mutation of the LH receptor, relative to a boy without such mutations. ***(7 points).***

The premature activation of the LH receptor will result in precocious puberty in the boy. Secondary sexual characteristics will appear very early.

b) After the male individual matures to the age of 20, what differences in hormones would be present relative to a normal individual of the same age? What would be the physiological effect of these hormonal changes? ***(6 points).***

High levels of testosterone in the individual will suppress GnRH, LH, and FSH secretion. The lowered FSH secretion likely will cause a low sperm count.

c) What physiological changes would be noted in an 8 year-old girl with an activating mutation of the LH receptor, relative to a girl without such mutations. ***(7 points).***

Little physiological change would be expected in the girl. if anything, she might be slightly androgenized due to LH stimulation of the theca. Since there isn't any FSH secretion, the androstenedione won't be converted to estradiol. With no E around, even this weak androgen will have an effect.

12) A professional athlete takes high doses of anabolic steroids as a "performance enhancer." The athlete believes that the steroid use will enhance his ability to father a child, since testosterone levels in his blood are higher than normal. Is the athlete correct in his assumption? Provide a brief explanation for your answer. ***(5 points).***

Although blood androgen levels are high, testicular androgen levels are lower than in a normal male. Since testosterone is synthesized in the testes, the levels there are extremely high in a normal individual. With anabolic steroid use, testicular testosterone secretion is suppressed through feedback inhibition. As a result, there is too little testosterone in the testes to support spermatogenesis.

13) Women who use the (progesterone-only) minipill as a contraceptive are advised that the pill must be taken at the same time every day (within an hour or so) and that missing even by a few hours constitutes a missed pill.

However, women taking combined oral contraceptives are told that while missing one day is not a good habit to get into, pills can be resumed the next day with fairly minimal risk of contraceptive failure.

Describe the mode of action of each of these two types of contraceptives. and explain why missing a minipill is more likely to result in contraceptive failure than missing a combined oral contraceptive. ***(10 points).***

The minipill mainly affects cervical mucus, and these alterations are rapidly reversed if progesterone levels change. A women taking the minipill can still ovulate, such that introduction of sperm into the reproductive tract can result in pregnancy. A combined oral contraceptive suppresses follicle development and ovulation. Thus, after a single missed pill, it is very unlikely that ovulation has occurred.

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