Medical Biochemistry Examination III

December 16, 1998
Kresge Auditorium

Please follow these directions:

1. Do not begin the exam until all students have received a copy of the exam. You will be instructed as to when to break the seal.

2. The exam consists of 27 questions on 6 pages, with this title page considered page 1. There are 50 points on this exam. The take-home essay was worth 20 points, so there are 70 points available for the exam. The point value for each question is indicated by the question. For multiple answer questions 0.25 points will be deducted for each incorrect answer, although the lowest point value assigned for a question is 0. **No multiple answer question will have more than 4 correct answers. There are only three such questions on this exam: numbers 14, 15 and 27.**

3. Place your ID number on every page of the exam booklet and on the answer sheets you will hand in. Also, print your name on the line provided on the answer sheets.

4. There is ONE answer sheet for this exam. **When using the answer sheet use a No. 2 pencil only.** Fill in the circle for the correct answer(s) completely. If you wish to change an answer, be sure to erase cleanly. Make sure that you use your biochemistry ID number to fill in the ID box. **You should convert your number to a three digit number (001, 010, etc) and use the three leftmost boxes to insert your number.**

5. When you are finished with the exam, return both the test booklet and the answer sheets. The test booklet will be returned to you when the grading is complete. Be sure to pick up the next section of the course syllabus as you leave.

6. Questions will not be allowed during the exam. If you believe there is a typographical error do the best you can with the information available. Do not spend extra time on the question. If it is determined that the information presented is ambiguous, or in error, then the question will not be counted in the final scoring.

7. Attached to the exam booklet after page 6 is a page for you to list your answers. You can take this page with you from the exam, and use it to check your answers against the posted answers (outside of room 3109 MSB). Answers will be posted after all students have taken the exam.

8. You will have **2 hours (until 10:30 am)** to complete this exam. Good luck.
Questions 1-16 should be answered from the lettered list presented below. Choose below the answer or answers which best match each question. A term may be used once, more than once, or not at all. The number of answers for a given question is indicated in the question except for questions 14 and 15, which have an undefined number of answers.

A. Triacylglycerol    H. Diacylglycerol    O. Free fatty acids (FFA or NEFA)
B. Cholesterol       I. Cardiolipin       P. Aldosterone
C. Cholesterol ester J. Bile Salts        Q. Cortisol
D. CDP-diacylglycerol K. Secondary bile acids R. Estradiol
E. Phosphatidylinositol L. Inositol Triphosphate (IP₃) S. Testosterone
F. Phosphatidylcholine M. Prostaglandin T. None of the above
G. Phosphatidylserine N. Micelles

1. (2 points) A patient has been referred to you with a serum lipoprotein profile showing an elevated pre-β (VLDL) band and normal levels of all other lipoproteins. Which **ONE** compound would you expect to be most markedly elevated in this patient’s blood?

2. (2 points) A patient has been referred to you with a familial deficiency of cholesterol ester transfer protein (CETP). You would expect to find that her HDL particles have a reduced content of which **ONE** compound?

3. (2 points) A patient with a defective LDL receptor would be likely to have elevated serum levels of which **ONE** compound?

4. (2 points) A 9 day old male infant presents at the emergency room with lethargy and bradychardia (reduced heart rate). Serum electrolyte values show a dramatic elevation in K⁺. After reducing the lifethreatening K⁺ to near normal levels, further analysis suggests a deficiency of 21-α-hydroxylase. What **TWO** compounds would you probably want to treat this patient with chronically?

5. (2 points) As part of a study on the regulation of cell growth, you have developed a transgenic mouse with reduced activity of phospholipase C. When cells from these mice are stimulated by the addition of growth factors, what **TWO** compounds would you expect to find are produced in below normal amounts?
6-7. (1 point each answer) A patient with a defect in 7-α-hydroxylase would have a deficiency of ____ (6) ____ which would in turn give rise to an impaired inability to form ____ (7) ____ required for proper lipid digestion (only ONE answer per question).

8. (2 points) Found predominantly on the cytoplasmic surface of the plasma membrane, this compound is involved in wound recognition (only ONE answer).

9. (2 points) Individuals with non-insulin dependent diabetes mellitus commonly have elevated levels of serum VLDLs. This is a consequence of increased hepatic VLDL production due to an elevation of which ONE compound in the blood?

10-11. (1 point each answer) In an individual with a constitutively active protein kinase A, you would expect to see increased rates of synthesis of ____ (10) ____ in the liver and increased rates of degradation of ____ (11) ____ in adipocytes (only ONE answer per question).

12. (2 points) Some antibiotics may cause a marked reduction in intestinal flora. Under such conditions, you might anticipate seeing a concommitant reduction in the levels of which ONE compound in the gall bladder?

13. (2 points) Failure to increase the production of this ONE compound shortly before birth is an important part of the etiology of respiratory distress syndrome.

14. (2 points) You have decided to treat a patient suffering from an antibiotic resistant form of E coli infection with an experimental pharmacological agent that acts as an inhibitor of the enzyme glycerol-3-phosphate acyl transferase. You reason that this should inhibit the pathway from glycerol-3-phosphate to phosphatidic acid. Based on your knowledge of the pathways of phospholipid biosynthesis, which of the above compounds would you expect to find that the bacteria could no longer synthesize? This question has an undefined number of answers. Indicate all correct answers on the answer sheet.

15. (2 points) Using the same inhibitor as in question 14, which of the above compounds would you predict that your patient could no longer synthesize while taking the drug? Indicate all correct answers on the answer sheet.

16. (2 points) This ONE compound is found almost exclusively in mitochondria.
Questions 17-19 (2 points each) should be answered from the lettered choices below. Choose from among the lettered terms those which best match each question. A term may be used once, more than once, or not at all.

A. Pancreatic lipase  
B. Lipoprotein lipase  
C. Hormone sensitive lipase  
D. Phospholipase A2  
E. 7-α-hydroxylase  
F. 21-α-hydroxylase  
G. 11-β-hydroxylase  
H. LCAT (PCAT)  
I. Phospholipase C  
J. ApoA-I  
K. ApoB48  
L. ApoB100  
M. ApoC-II  
N. ApoC-III  
O. ApoE  
P. ACAT

17. Defects in each of these **FOUR** proteins can lead to deficiencies in the fat soluble vitamins.

18. Defects in either of these **TWO** proteins would be expected to cause impaired reverse cholesterol transport without significantly affecting other lipid transport processes.

19. In an individual with a defect in this **ONE** protein, you might expect to see an *increased* rate of clearance from the serum of VLDL, HDL, and chylomicrons.

20. (2 points) Which **TWO** of the following are **NOT** used by the body as part of the normal mechanisms for *regulating* cholesterol metabolism?

   A. LDL receptor synthesis  
   B. Insulin release  
   C. Glucagon release  
   D. Activity of hepatic lipase  
   E. Activity of HMGCoA synthase  
   F. Degradation rate of HMGCoA reductase
21. (2 points) In the events leading from elevated serum LDL concentrations to the formation of the fatty streak, select from the list below the TWO items which are not involved in this process.

A. LDL oxidation
B. Release of prostaglandins
C. Macrophage differentiation
D. Elevation of cytoplasmic calcium
E. Chemoattractants
F. Unregulated OX-LDL receptors
G. Foam cells

Questions 22-25 (2 points each) should be answered from the lettered lists below. Each question has two answers; one is the enzyme which is defective in the disease (answers A through I), and the second answer is the substrate that accumulates when the disease is manifest (answers J through O). Thus each question has one correct answer from choices A - I, and a second correct answer from choices J - O.

A. β-Glucosidase
B. Ceraminidase
C. β-Galactosidase
D. Arylsulfatase A
E. α-Galactosidase
F. β-Hexosaminidase A&B
G. Sphingomyelinase
H. β-Hexosaminidase A
I. α-Galactosidase

J. Increased GM1
K. Increased GM2
L. Increased GM3
M. Increased ceramide
N. Increased sphingosine
O. Decreased ceramide formation

22. Krabbe’s Disease
23. Tay-Sachs Disease
24. Niemann-Pick Disease
25. Farber’s disease
26. (2 points) Embryonic brain development requires not only an increase of neurons via cell division, but also the loss of specific neurons through a process of programmed cell death. A defect in which **ONE** of the following enzymes might be associated with an inability to carry out the cell death program?

A. β-glucosidase  
B. Ceramide activated protein kinase (CAPK)  
C. Neutral sphingomyelinase (NSM)  
D. Acidic sphingomyelinase (ASM)  
E. None of the above

27. (2 points) Which of the following enzymes or compounds is/are involved in the synthesis of **BOTH** ketone bodies and cholesterol? (This is a multiple answer question - indicate all correct answers which apply, a penalty will be imposed for incorrect answers)

A. mevalonate  
B. acetoacetylCoA  
C. HMGCoA lyase  
D. HMGCoA synthase  
E. All of the above  
F. None of the above
ANSWERS, Medical Biochemistry Exam 3, 12/16/98

1. A
2. A
3. A or B
4. P, Q
5. H, L
6. J
7. N
8. G
9. O
10. T
11. A
12. K
13. F
15. T
16. I
17. A, D, E, K
18. H, J
19. N
20. D, E
21. B, D
22. C, O
23. H, K
24. G, O
25. B, M
26. D
27. B, D