15th Annual Mayo Clinic Update in Nephrology and Transplantation

February 10-11, 2017
Scottsdale Marriott at McDowell Mountains
Scottsdale, Arizona

PROGRAM HIGHLIGHTS:
- Ultrasound Workshop
- Multidisciplinary TMA aHUS Workshop
- Opportunity for Abstract Presentation

Course Director:
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MAYO CLINIC ABIM MAINTENANCE OF CERTIFICATION LEARNING SESSION
Mayo Clinic

Maintenance of Certification Learning Session

Mayo Clinic will host a Maintenance of Certification Learning Session that will feature the American Board of Internal Medicine (ABIM) Update in Nephrology medical knowledge module.

The Learning Session will be held on Saturday, February 11, 2016

Update in Nephrology
A7-S Version 16-1 – 2016 Update

The primary purpose of the Learning Session is to facilitate completion of ABIM medical knowledge modules by board-certified internists and subspecialists of internal medicine in order for them to receive Maintenance of Certification credit. Learning Sessions are conducted in an interactive group setting with educational support and are led by ABIM-certified physicians.

Participants who are enrolled in ABIM’s Maintenance of Certification program can order a copy of the Update in Nephrology from ABIM’s website, www.abim.org, and transfer and submit the answers discussed during the Learning Session to ABIM for scoring. ABIM will send participants a score report that confirms whether or not the module was completed successfully. Those who complete the module successfully will receive 10 points per 30-question module, toward ABIM’s Self-Evaluation of Medical Knowledge requirement for Maintenance of Certification. In addition, CME credit for completing ABIM modules is available through a program jointly sponsored by ABIM and the American College of Physicians. Successful completion of the ABIM Update in Nephrology medical knowledge module qualifies for 2 AMA PRA Category 1 Credit(s)™. You must be enrolled in ABIM’s Maintenance of Certification program to submit completed medical knowledge modules for scoring, feedback reports, and eligibility to receive Maintenance of Certification and CME credit.

For additional information about the ABIM Maintenance of Certification program requirements, visit ABIM’s website, www.abim.org or call the ABIM Contact Center, 800-441-ABIM, extension 3598. To enroll in Maintenance of Certification go to your password-protected “Home Page” in the Physician Login (formerly On-Line Services) section of www.abim.org. Once enrolled, you will be able to order an ABIM medical knowledge module from your “Home Page.”
REGISTRATION INFORMATION

To participate in the Learning Session:

The Maintenance of Certification Learning Session is part of your course registration. If you are not enrolled in the ABIM MOC program through ABIM, then you may need to pay an additional fee to ABIM to access the official module to submit your answers for MOC credit. Please bring your laptop, tablet or smartphone with you to so that you can enroll in the ABIM MOC program and order the module at the beginning of the session on February 11, 2017. Course staff will be present during the session to assist with enrollment with ABIM as needed.

1) Mayo Clinic will provide you with a “Learner’s Copy” of the ABIM Update in Nephrology at the session on February 11, 2017.

2) To enroll in the ABIM MOC program visit the ABIM website: [www.abim.org](http://www.abim.org) and go to the physician login tab in the upper right-hand corner. You will need your 6-digit ABIM ID. If you do not know your ID, follow the instructions on the screen. If this is your first time using the website, you will have to create an online account with a password.

3) Login to your account (you will need your 6-digit ABIM ID and your password). This will take you to your ABIM homepage.

4) Under “My Maintenance of Certification (MOC) Program,” order the “2016 Update in Nephrology (A7S).” You do not need to pay for the module if you are already enrolled in MOC. Once you order the module, it will show up in your ABIM homepage at the bottom.

5) If you were unable to bring a laptop, tablet or smartphone with you to the session to work through the questions live, please submit your answers to ABIM as soon as possible for MOC credit by completing and submitting your “official” internet copy (you must be connected to the internet in order for your answers to be successfully transmitted to ABIM). If you need assistance submitting your answers please call 800-441-ABIM.
# Common Abbreviations

The following abbreviations may be used in this module:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A₂</td>
<td>Aortic valve component of second heart sound</td>
</tr>
<tr>
<td>ACE</td>
<td>Angiotensin-converting enzyme</td>
</tr>
<tr>
<td>ADPKD</td>
<td>Autosomal dominant polycystic kidney disease</td>
</tr>
<tr>
<td>AIDS</td>
<td>Acquired immunodeficiency syndrome</td>
</tr>
<tr>
<td>AKI</td>
<td>Acute kidney injury</td>
</tr>
<tr>
<td>ALT</td>
<td>Alanine aminotransferase</td>
</tr>
<tr>
<td>ANCA</td>
<td>Antineutrophil cytoplasmic antibody</td>
</tr>
<tr>
<td>AST</td>
<td>Aspartate aminotransferase</td>
</tr>
<tr>
<td>BMI</td>
<td>Body mass index</td>
</tr>
<tr>
<td>BPM</td>
<td>Beats per minute</td>
</tr>
<tr>
<td>BUN</td>
<td>Blood urea nitrogen</td>
</tr>
<tr>
<td>C3</td>
<td>Complement C3</td>
</tr>
<tr>
<td>CKD</td>
<td>Chronic kidney disease</td>
</tr>
<tr>
<td>CMV</td>
<td>Cytomegalovirus</td>
</tr>
<tr>
<td>DOQI</td>
<td>Disease Outcomes Quality Initiative</td>
</tr>
<tr>
<td>ELISA</td>
<td>Enzyme-linked immunoabsorbent assay</td>
</tr>
<tr>
<td>ESRD</td>
<td>End-stage renal disease</td>
</tr>
<tr>
<td>FSGS</td>
<td>Focal and segmental glomerulosclerosis</td>
</tr>
<tr>
<td>GBM</td>
<td>Glomerular basement membrane</td>
</tr>
<tr>
<td>GFR</td>
<td>Glomerular filtration rate</td>
</tr>
<tr>
<td>HLA</td>
<td>Human leukocyte antigen</td>
</tr>
<tr>
<td>HMG CoA</td>
<td>Hydroxymethylglutaryl coenzyme A</td>
</tr>
<tr>
<td>IgAN</td>
<td>Immunoglobulin A nephropathy</td>
</tr>
<tr>
<td>INR</td>
<td>International normalized ratio</td>
</tr>
<tr>
<td>KDIGO</td>
<td>Kidney Disease Improving Global Outcomes</td>
</tr>
<tr>
<td>KDOQI</td>
<td>Kidney Disease Outcomes Quality Initiative</td>
</tr>
<tr>
<td>Kt/V</td>
<td>Urea clearance divided by volume of distribution</td>
</tr>
<tr>
<td>MDMA</td>
<td>Methylenedioxymethamphetamine</td>
</tr>
<tr>
<td>NPH</td>
<td>Neutral protamine hagedorn</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>PaCO₂</td>
<td>Arterial partial pressure of carbon dioxide</td>
</tr>
<tr>
<td>PaO₂</td>
<td>Arterial partial pressure of oxygen</td>
</tr>
<tr>
<td>PTFE</td>
<td>Polytetrafluoroethylene</td>
</tr>
<tr>
<td>PTH</td>
<td>Parathyroid hormone</td>
</tr>
<tr>
<td>RBCs</td>
<td>Red blood cells</td>
</tr>
<tr>
<td>S₃</td>
<td>Third heart sound (ventricular gallop)</td>
</tr>
<tr>
<td>S₄</td>
<td>Fourth heart sound (atrial gallop)</td>
</tr>
<tr>
<td>TGF</td>
<td>Transforming growth factor</td>
</tr>
<tr>
<td>WBCs</td>
<td>White blood cells</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
</tbody>
</table>
Introduction

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Please read the following information carefully.

On successful completion of this module, you will receive 10 points of self-evaluation of medical knowledge credit in the Maintenance of Certification Program; credit remains valid for 10 years.

Instructions
Read each one-best-answer question in the module and indicate your answer by clicking in the appropriate box. You should use educational resources (e.g., online medical references, textbooks, journal articles) to assist in answering the questions. Suggested resources are listed in the Education Resources section of the CME information.

On each question screen, the Help button will provide you with technical information and instructions on how to navigate through the module, including submitting your completed module. For common abbreviations that may appear in this module, click the "Resources" button on the right side of the screen.

CME information for this module, including CME expiration date, may be reviewed by clicking the “CME Credit for the ABIM Maintenance of Certification Program” link in the left-hand column.

Laboratory Studies and Reference Ranges
Reference ranges for laboratory test reports are included in the text of the ABIM exam questions. As is true in practice, interpretation of a particular patient’s test result in relation to the reference range depends on the clinical context. For example, reference ranges for tests assessing lipid or glucose metabolism may not be applicable in certain clinical settings; ABIM reference ranges should not be confused with patient-specific targets for such tests.

Information on specific studies
The National Cancer Institute advises that there is no specific normal or abnormal level of prostate-specific antigen (PSA) in the blood. Therefore, ABIM is reporting “no specific normal or abnormal level” in place of the reference range for PSA.

The comprehensive metabolic panel contains the following assays: Albumin, alanine and aspartate aminotransferases (ALT and AST), alkaline phosphatase, total bilirubin, blood urea nitrogen, calcium, creatinine, electrolytes (sodium, potassium, chloride, and bicarbonate), glucose, and total protein.

Unless noted otherwise in examination questions:
- Arterial blood gas studies are done at sea level with the patient breathing room air
- Reticulocyte counts are uncorrected
- Tuberculin skin tests are done with purified protein derivative (PPD) at intermediate strength (5 TU)
- Electrocardiograms are recorded at normal standard and speed
- Lung volumes are determined by body plethysmography
Illustrations and Multimedia (if applicable)
Some questions are accompanied by illustrations, such as radiographs, electrocardiograms, photographs of physical or histologic findings, videos, and charts. All electrocardiograms are recorded at normal standard and speed unless otherwise specified.

Criteria for successful completion
In order to successfully complete this module and receive Maintenance of Certification credit, you must answer every question. Submission of this module will not be accepted until answers have been provided for every question.
A 55-year-old black man who received a deceased donor kidney transplant five years ago undergoes evaluation for increasing proteinuria. Transplantation was required for end-stage renal disease due to hypertensive nephrosclerosis. Three years ago, the patient had one acute rejection, which was treated with pulse corticosteroids. He has missed several clinic visits. Current medications are tacrolimus (3 mg twice daily), mycophenolate mofetil (750 mg twice daily), prednisone (5 mg daily), amlodipine (10 mg daily), telmisartan-hydrochlorothiazide, atorvastatin, and fish oil.

On physical examination, the patient’s blood pressure is 150/85 mm Hg. His systolic blood pressure has often been between 140 and 150 mm Hg in clinic. He does not take blood pressure measurements at home.

Laboratory studies:

- Complete blood count: Normal
- Serum creatinine: Stable at 1.81 mg/dL [0.7–1.5]
- Blood tacrolimus, trough: 6 ng/mL [target: 5–10]
  (previously intermittently less than 5 ng/mL)
- Urine protein-to-creatinine ratio:
  2.0 mg/mg [less than 0.2]
  (6 months ago: 1.5 mg/mg)
  (12 months ago: 0.8 mg/mg)

Which of the following would be the most likely cause of this patient’s proteinuria?

(A) Hypertensive nephrosclerosis
(B) Calcineurin inhibitor nephrotoxicity
(C) Transplant glomerulopathy
(D) De novo membranous glomerulopathy
A 42-year-old black man who recently moved to your area is referred to you for management of chronic kidney disease (CKD) and hypertension (HTN). His family history is positive for kidney disease related to HTN, and several of his relatives are receiving dialysis. His current medications are amlodipine, irbesartan, carvedilol, furosemide, and rosuvastatin.

Physical examination is normal except for blood pressure (BP) of 140/80 mm Hg.

Laboratory studies:

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum creatinine</td>
<td>1.93 mg/dL [0.7–1.5]</td>
</tr>
<tr>
<td>Urine protein-to-creatinine ratio</td>
<td>0.4 mg/mg [less than 0.2]</td>
</tr>
</tbody>
</table>

While discussing the above findings, the patient tells you that he has heard that there is a genetic cause of end-stage renal disease in blacks and asks you what is known about this genetic cause.

Which of the following statements best describes what is known about the significance of carrying APOL1 risk variants?

(A) In hypertensive patients with two APOL1 risk alleles, CKD progression is seen only in those with proteinuria

(B) Greater decline in GFR in black patients with two APOL1 risk alleles versus white patients is seen only in patients who have diabetes mellitus

(C) Two APOL1 risk variants are required to increase the risk of CKD progression

(D) All the variants of the APOL1 gene are associated with an enhanced risk of CKD progression
A 68-year-old man who has end-stage renal disease from membranous nephropathy is about to start home peritoneal dialysis. The patient is otherwise healthy. He inquires about kidney transplantation. His 30-year-old daughter has offered to be a donor. However, she has just started graduate school and the patient is reluctant to interrupt her studies for the next three to four years. The average wait time in his region for a deceased donor kidney from a young healthy donor exceeds three years.

Which of the following options would offer this patient the best survival advantage?

(A) Remain on peritoneal dialysis instead of transplantation  
(B) Wait for his daughter to finish graduate school and then accept a kidney from her  
(C) Accept a kidney from an older or less healthy deceased donor  
(D) Wait for a kidney from a young healthy deceased donor
A 33-year-old female endurance athlete who is in excellent health has the onset of a headache, nausea, and cramping abdominal pain six hours into an ultra-marathon race being held on a hot summer day at 2.4 kilometers (8000 feet) above sea level. She tells the physician in attendance that she has voided urine only once during the race despite drinking copious amounts of a brand-name sports drink to avoid dehydration. She takes no medications.

The patient is diaphoretic and feels light-headed. Her temperature is 37.1 C (98.8 F). Physical examination reveals pulse rate of 90 per minute with a regular rhythm, respirations of 20 per minute, and blood pressure of 100/70 mm Hg. Mucous membranes are dry, and skin is warm and moist. The lungs are clear. No peripheral edema is noted.

Laboratory studies:

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood urea nitrogen</td>
<td>25 mg/dL [8–20]</td>
</tr>
<tr>
<td>Serum creatinine</td>
<td>1.11 mg/dL [0.7–1.5]</td>
</tr>
<tr>
<td>Serum electrolytes:</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>110 mEq/L [136–145]</td>
</tr>
<tr>
<td>Potassium</td>
<td>3.3 mEq/L [3.5–5.0]</td>
</tr>
<tr>
<td>Chloride</td>
<td>80 mEq/L [98–106]</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>21 mEq/L [23–28]</td>
</tr>
<tr>
<td>Urine specific gravity</td>
<td>1.030 [1.002–1.030]</td>
</tr>
</tbody>
</table>

Which of the following is the most likely cause of this patient’s electrolyte abnormalities?

(A) Hypovolemic hyponatremia
(B) Excessive salt loss from profuse sweating
(C) Urinary salt wasting due to cerebral edema from altitude sickness
(D) Excessive intake of hypotonic fluids in the presence of increased vasopressin
A 66-year-old man who has long-standing well-controlled hypertension comes to the emergency department and is found to have uncontrolled hypertension, new-onset shortness of breath, and a serum creatinine that has increased from 0.83 to 1.32 mg/dL [0.7–1.5] over the past 6 months. Two years ago, the patient had a non-ST-segment elevation myocardial infarction; he also has a 40-pack-year history of cigarette smoking. Current outpatient medications are chlorthalidone, irbesartan, and amlodipine. Pulmonary edema is diagnosed. He is admitted to the hospital and treated for hypertension and pulmonary edema. You are asked to evaluate the patient after the pulmonary edema has resolved.

On physical examination, pulse rate is 76 per minute, and blood pressure 180/110 mm Hg. Jugular venous pressure is elevated. Cardiac examination shows a normal heart rate and regular rhythm, with no murmurs. The lungs are clear.

Laboratory studies:

- Blood urea nitrogen: 22 mg/dL [8–20]
- Serum creatinine: 1.50 mg/dL [0.7–1.5]
- Urinalysis: Normal

Magnetic resonance angiography shows 90% narrowing of the right renal artery, a 10-cm right kidney, 30% narrowing of the left renal artery, and a 9.2-cm left kidney.

You order antihypertensive and antihyperlipidemic medications.

Which of the following should you recommend now?

(A) No additional interventions
(B) Angioplasty and stenting of the left renal artery
(C) Angioplasty and stenting of the right renal artery
(D) Angioplasty and stenting of both the right and left renal arteries
A 25-year-old man who was found to have hypertension and hematuria on screening for military service has been referred to you. Medical history is noncontributory. Current medication is amlodipine. The patient played sports in high school and community college.

Physical examination is notable for blood pressure of 150/58 mm Hg.

Laboratory studies:

- Blood urea nitrogen: 25 mg/dL [8–20]
- Serum creatinine: 1.21 mg/dL [0.7–1.5]
- Serum electrolytes: Normal
- Urine protein-to-creatinine ratio: 0.6 mg/mg [less than 0.2]
- Urinalysis:
  - WBCs: 4–5/hpf
  - RBCs: 8–10/hpf

Kidney biopsy is performed (results return before blood test results). Hypercellular glomeruli are seen on light microscopy. Immunofluorescence microscopy shows only C3 deposits along the capillary walls. Electron microscopy demonstrates electron-dense material that is expanding the basement membrane; the material is less electron dense and less well defined than in dense deposit disease. Representative images obtained during light microscopy, electron microscopy, and immunofluorescence are shown.

Which of the following is the most likely diagnosis?

(A) Lupus nephritis  
(B) C3 glomerulopathy  
(C) Membranous nephropathy  
(D) Dense deposit disease
A 72-year-old woman who has stage 4 chronic kidney disease (CKD) due to diabetes mellitus comes to the emergency department for shortness of breath, fatigue, and edema. Her appetite has decreased. She has participated in end-stage-renal-disease education and planning in the CKD clinic and has expressed a strong preference for peritoneal dialysis over hemodialysis.

The patient is afebrile. Heart rate is 64 beats per minute, and blood pressure is 138/72 mm Hg. Arterial oxygen saturation is 94% on room air. Physical examination shows jugular venous pressure of 8 cm H₂O. Lung examination reveals crackles at both lung bases. Edema (1+) is noted.

Laboratory studies:

- Blood urea nitrogen 54 mg/dL [8–20]
- Serum creatinine 5.02 mg/dL [0.7–1.5]
- Estimated glomerular filtration rate 9 mL/min/1.73 m²
- Serum electrolytes:
  - Sodium 132 mEq/L [136–145]
  - Potassium 4.5 mEq/L [3.5–5.0]
  - Chloride 88 mEq/L [98–106]
  - Bicarbonate 20 mEq/L [23–28]

The patient is started on intravenous furosemide, with good diuresis. But after two days, kidney function has failed to improve.

Which of the following is the best dialysis option for this patient, in accord with her stated preferences?

(A) Placement of a peritoneal dialysis catheter and slow initiation of peritoneal dialysis now
(B) Placement of a tunneled central venous catheter and initiation of hemodialysis now
(C) Placement of a temporary central venous catheter and initiation of hemodialysis now
(D) Placement of an arteriovenous graft and initiation of hemodialysis in two weeks
A 35-year-old man with long-standing polycystic kidney disease (PKD), liver and kidney cysts, type 2 diabetes mellitus, hypertension, and hepatitis C has increases in serum alanine aminotransferase (ALT) and total bilirubin. Current medications are tolvaptan, metformin, lisinopril, and hydrochlorothiazide.

Laboratory studies:

- Hemoglobin A\textsubscript{1C} 7.2% [4.0%–5.6%]
- Blood urea nitrogen 18 mg/dL [8–20]
- Serum creatinine 1.42 mg/dL [0.7–1.5] (unchanged from one year ago)
- Serum total bilirubin 3.2 mg/dL [0.3–1.0]
- Serum ALT 123 U/L [10–40]
- Serum complements
  - C3 138 mg/dL [100–233]
  - C4 36 mg/dL [14–48]

Ultrasound scanning of the kidneys and liver shows multiple cysts, unchanged from one year ago.

Which of the following is the most likely cause of the increase in serum ALT and bilirubin in this patient?

(A) Hepatitis C
(B) Tolvaptan
(C) Metformin
(D) Progression of PKD
A 69-year-old man comes to the emergency department and is found to have sepsis of urinary tract origin associated with a retained kidney stone. The patient currently takes no medication.

Temperature is 38.2 C (100.8 F), pulse rate is 120 per minute, and blood pressure is 88/60 mm Hg. Physical examination shows the urinary catheter in place.

Laboratory studies:

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin</td>
<td>9.0 g/dL [14–18]</td>
</tr>
<tr>
<td>Blood urea nitrogen</td>
<td>26 mg/dL [8–20]</td>
</tr>
<tr>
<td>Serum creatinine</td>
<td>1.73 mg/dL [0.7–1.5] (baseline: 0.81 mg/dL)</td>
</tr>
<tr>
<td>Serum electrolytes:</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>138 mEq/L [136–145]</td>
</tr>
<tr>
<td>Potassium</td>
<td>4.9 mEq/L [3.5–5.0]</td>
</tr>
<tr>
<td>Chloride</td>
<td>106 mEq/L [98–106]</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>15 mEq/L [23–28]</td>
</tr>
</tbody>
</table>

In addition to crystalloids and antibiotics, which of the following should you recommend to decrease this patient’s risk of acute kidney injury?

- (A) No additional therapy
- (B) Hydroxyethyl starch
- (C) Albumin
- (D) Sodium bicarbonate
- (E) Packed red blood cells
In a recent controlled trial, patients who had chronic kidney disease due to diabetes mellitus and were receiving renin-angiotensin-aldosterone system inhibitors were given patiromer for treatment of hyperkalemia.

Which of the following was demonstrated by the trial?

(A) Serum potassium levels increased after the drug was stopped
(B) Serum potassium levels remained decreased after the drug was stopped
(C) Greater decreases in serum potassium were observed in patients with the lowest serum potassium levels
(D) Hypermagnesemia was a commonly observed adverse effect
A 40-year-old woman undergoes evaluation for a 9.1-kg (20.0-lb) weight gain over a one-month period and new-onset of generalized edema. The patient reports no other symptoms, and medical history is noncontributory. Current medications are furosemide, 80 mg daily; losartan, 50 mg daily; and atorvastatin, 20 mg daily.

Body mass index is 26. Blood pressure is 130/85 mm Hg. Physical examination shows no enlarged lymph nodes and no liver or spleen enlargement. The skin and joints are normal. There is pitting edema (3+) of the legs extending to the knees.

Laboratory studies:

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum albumin</td>
<td>2.0 g/dL [3.5–5.5]</td>
</tr>
<tr>
<td>Serum creatinine</td>
<td>1.04 mg/dL [0.7–1.5]</td>
</tr>
<tr>
<td>Low-density lipoprotein cholesterol</td>
<td>130 mg/dL [borderline-high: 130–159]</td>
</tr>
<tr>
<td>Complements C3 and C4</td>
<td>Normal</td>
</tr>
<tr>
<td>Anti-phospholipase A2 receptor (PLA2R)</td>
<td>Negative</td>
</tr>
<tr>
<td>Urine protein-to-creatine ratio</td>
<td>12 mg/mg [less than 0.2]</td>
</tr>
</tbody>
</table>

Kidney biopsy demonstrates stage 2 membranous nephropathy. Immunofluorescence shows IgG4 (3+), IgG1 and IgG3 (trace), and C3 (3+). No C1q or PLA2R is detected. Electron microscopy reveals exclusively subepithelial immune deposits.

Antibodies to which of the following antigens would most likely be positive in this patient?

(A) Thrombospondin type-1 domain-containing 7A (THSD7A)
(B) Double-stranded DNA (dsDNA)
(C) Cationic bovine serum albumin (cBSA)
(D) Neutral endopeptidase (NEP)
A 55-year-old woman who has uncontrolled hypertension is started on omeprazole for the treatment of duodenal ulcer disease. Current medications are hydrochlorothiazide, lisinopril, and amlodipine. 

Pulse rate is 76 per minute, and blood pressure is 165/95 mm Hg. Physical examination is otherwise unremarkable.

Laboratory studies:

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood urea nitrogen</td>
<td>22 mg/dL [8–20]</td>
</tr>
<tr>
<td>Serum creatinine</td>
<td>0.93 mg/dL [0.7–1.5]</td>
</tr>
<tr>
<td>Urinalysis</td>
<td>Normal</td>
</tr>
</tbody>
</table>

Which of the following is the most common electrolyte disorder associated with proton pump inhibitor therapy?

(A) Metabolic alkalosis
(B) Hypomagnesemia
(C) Hypocalcemia
(D) Hypokalemia
A 56-year-old man who has end-stage renal disease due to diabetic nephropathy has been receiving dialysis for the past three years. Current medications are metoprolol, amlodipine, calcium citrate three times daily with meals, and a vitamin D supplement.

Laboratory studies:

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin</td>
<td>11.4 g/dL [14–18]</td>
</tr>
<tr>
<td>Serum ferritin</td>
<td>186 ng/mL [20–235]</td>
</tr>
<tr>
<td>Transferrin saturation</td>
<td>20% [20%–50%]</td>
</tr>
<tr>
<td>Serum calcium</td>
<td>9.0 mg/dL [8.6–10.2]</td>
</tr>
<tr>
<td>Serum phosphorus</td>
<td>7.2 mg/dL [3.0–4.5]</td>
</tr>
<tr>
<td>Serum intact parathyroid hormone</td>
<td>515 pg/mL [target: 130–585]</td>
</tr>
</tbody>
</table>

Which of the following is most likely to have beneficial effects on serum ferritin level and transferrin saturation, as well as serum phosphorus, in this patient?

(A) Lanthanum carbonate  
(B) Sevelamer  
(C) Ferric citrate  
(D) Sucroferric oxyhydroxide
A 65-year-old man who has metastatic renal cell carcinoma comes to your office for evaluation at the request of his oncologist. One year ago, the patient underwent left nephrectomy for renal cell carcinoma after evaluation for bone pain and lung metastases. He had no response to interferon therapy. The patient’s oncologist plans to treat him with a late-generation tyrosine kinase inhibitor and has asked you to monitor his renal and electrolyte status.

The patient appears healthy. Physical examination is unremarkable.

Laboratory studies:

- Serum creatinine: 1.12 mg/dL [0.7–1.5]
- Serum calcium: 10.3 mg/dL [8.6–10.2]
- Serum phosphorus: 3.3 mg/dL [3.0–4.5]
- Serum magnesium: 2.0 mEq/L [1.6–2.6]

Which of the following off-target effects should you expect?

(A) Hyperuricosuria and hyperuricemia
(B) Hypocalciuria and hypercalcemia
(C) Hypomagnesuria and hypermagnesemia
(D) Hyperphosphaturia and hypophosphatemia
(E) Increased serum creatinine without an increase in blood urea nitrogen
A 38-year-old woman is being referred to a transplant center for renal transplant evaluation. For the past year, the patient has received dialysis for end-stage renal disease due to atypical hemolytic uremic syndrome (aHUS) after pregnancy. Her clinical course has finally stabilized so that consideration for renal transplantation is possible. She had no renal disease prior to the postpartum acute kidney injury. Evaluation revealed low levels of complement factor H. Current medications are amlodipine, sevelamer, calcitriol, and darbepoetin alfa. The patient has a friend who wants to donate a kidney.

On physical examination, blood pressure is 122/80 mm Hg.

In addition to alerting the transplant center staff about the primary diagnosis, you should discuss with them which of the following options?

(A) Avoidance of calcineurin inhibitors
(B) Possible utilization of eculizumab
(C) Monitoring of complement factor H levels
(D) Monitoring of terminal complement level
A 28-year-old man drank methanol and ethanol as part of a suicide attempt. He was found by friends and brought to the emergency department.

On physical examination, pulse rate is 96 per minute, respirations are 6 per minute, and blood pressure is 110/60 mm Hg.

Laboratory studies:

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood urea nitrogen</td>
<td>12 mg/dL [8–20]</td>
<td></td>
</tr>
<tr>
<td>Serum creatinine</td>
<td>0.83 mg/dL [0.7–1.5]</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>140 mEq/L [136–145]</td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td>4.6 mEq/L [3.5–5.0]</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>100 mEq/L [98–106]</td>
<td></td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>11.0 mEq/L [23–28]</td>
<td></td>
</tr>
<tr>
<td>Serum osmolality</td>
<td>340 mOsm/kg H_2O [275–295]</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.01 [7.38–7.44]</td>
<td></td>
</tr>
<tr>
<td>PaCO₂</td>
<td>40 mm Hg [38–42]</td>
<td></td>
</tr>
<tr>
<td>Blood ethanol</td>
<td>40 mg/dL [intoxication: 80–100 or greater]</td>
<td></td>
</tr>
<tr>
<td>Blood methanol</td>
<td>105 mg/dL [toxic concentration: 10 or greater]</td>
<td></td>
</tr>
</tbody>
</table>

Which of the following should you recommend for therapy at this time?

(A) Ethanol
(B) Fomepizole
(C) Fomepizole and intermittent hemodialysis
(D) Fomepizole and continuous venovenous hemodialysis
A 32-year-old woman who has long-standing type 1 diabetes mellitus is found to have end-stage renal disease and elects to begin peritoneal dialysis. Current medications are insulin, amlodipine, and furosemide.

Pulse rate is 76 per minute, and blood pressure is 152/90 mm Hg. Physical examination is notable for peripheral edema and peripheral neuropathy.

Laboratory studies:

- Blood urea nitrogen: 86 mg/dL [8–20]
- Serum creatinine: 5.82 mg/dL [0.7–1.5]
- Urine protein: 6300 mg/24 hr [less than 100]
- Urinalysis Protein: 4+

A neutral-pH peritoneal dialysis solution such as icodextrin would have which of the following major beneficial effects on this patient’s clinical outcome?

(A) Reduced risk of peritonitis
(B) Increased probability of patient survival
(C) Increased peritoneal ultrafiltration rate
(D) Reduced risk of hospitalization
A 45-year-old man who has obesity and difficult-to-control hypertension comes to your office to discuss possible Roux-en-Y bariatric surgery, which he has read about on the internet. He asks your opinion about the long-term risks associated with the surgery. Current medications are hydrochlorothiazide, lisinopril, amlodipine, and labetalol.

Body mass index is 40.3. Repeat measurement shows blood pressure is 150/90 mm Hg and 150/95 mm Hg.

Laboratory studies:

- Blood urea nitrogen: 21 mg/dL [8–20]
- Serum creatinine: 1.50 mg/dL [0.7–1.5]
- Urine protein: 225 mg/24 hr [less than 100]

Which of the following is the major risk of successful bariatric surgery?

(A) D-Lactic acidosis
(B) Worsening hypertension
(C) Focal and segmental glomerulosclerosis
(D) Increase in the number of renal calculi
Two clinical trials showed that therapy with rituximab plus corticosteroids or with cyclophosphamide plus corticosteroids was equally effective in inducing remission in antineutrophil cytoplasmic antibody (ANCA)-associated systemic vasculitis.

In comparing rituximab plus corticosteroids to cyclophosphamide plus corticosteroids, which of the following outcomes of the Rituximab in ANCA-Associated Vasculitis (RAVE) trial was found when follow-up of patients with renal vasculitis was extended out to 18 months?

<table>
<thead>
<tr>
<th>Persistence of complete remission</th>
<th>Adverse event rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Superior</td>
<td>Similar</td>
</tr>
<tr>
<td>(B) Inferior</td>
<td>Similar</td>
</tr>
<tr>
<td>(C) Equal</td>
<td>Similar</td>
</tr>
<tr>
<td>(D) Equal</td>
<td>Higher</td>
</tr>
</tbody>
</table>
A 55-year-old black man who has end-stage renal disease due to hypertension is about to start hemodialysis. In the educational training before his first visit with you, he was offered the option of nocturnal home hemodialysis with longer hours and more sessions than those with in-center hemodialysis. The patient also has hyperparathyroidism and anemia. Current medications are amlodipine, carvedilol, lisinopril, sevelamer, calcitriol, sodium bicarbonate, and darbepoetin alfa.

Body mass index is 29. Blood pressure is 150/90 mm Hg. Physical examination reveals a systolic murmur and peripheral edema (2+). Laboratory studies show blood urea nitrogen is 75 mg/dL [8–20] and serum creatinine is 8.12 mg/dL [0.7–1.5]. Echocardiography demonstrates moderately severe left ventricular hypertrophy.

The patient asks your opinion about the advantages of the home hemodialysis offered to him.

You should tell him that evidence suggests that frequent nocturnal home hemodialysis is associated with which of the following?

(A) Improved cognitive function  
(B) Improved survival  
(C) Fewer bone fractures  
(D) Reduced left ventricular mass
21

A 27-year-old man who has a known seizure disorder stops taking his antiseizure medications. Over the next week, he does not feel well and begins to drink excessive amounts of tea and soda. He has a generalized seizure and is brought to the emergency department.

The patient’s weight is 80.0 kg (176.2 lb). On physical examination, he is in a postictal state; the examination is otherwise unremarkable.

Laboratory studies:

- Plasma glucose 85 mg/dL [70–99]
- Blood urea nitrogen 4.0 mg/dL [8–20]
- Serum creatinine 0.41 mg/dL [0.7–1.5]
- Sodium 105 mEq/L [136–145]
- Potassium 3.0 mEq/L [3.5–5.0]
- Chloride 70 mEq/L [98–106]
- Bicarbonate 26 mEq/L [23–28]
- Urine osmolality 40 mOsm/kg H₂O [38–1400]
- Urine sodium 15 mEq/L [varies]
- Urine potassium 5.0 mEq/L [varies]

Over the initial four hours in the hospital, the patient’s urine output is 5000 mL and serum sodium increases to 120 mEq/L.

Which of the following should you recommend for therapy at this time?

(A) 3% Sodium chloride
(B) 5% Dextrose in water
(C) Desmopressin acetate
(D) 5% Dextrose in water and desmopressin acetate
A 35-year-old woman who has type 2 diabetes mellitus is referred to your office by her primary care provider for albuminuria. During the visit, she inquires about starting treatment with a drug from the new class of oral hypoglycemic agents known as sodium-glucose cotransporter-2 (SGLT2) inhibitors that has been approved by the U.S. Food and Drug Administration (FDA). The patient hopes that treatment with the new drug will make it possible to reduce or perhaps even discontinue treatment with insulin. The patient’s diabetes was diagnosed five years ago and had been poorly controlled with older-generation oral hypoglycemic agents. Recently, she started treatment with twice-daily NPH insulin. Other current medications are metformin and glyburide.

Body mass index is 30. Blood pressure is 128/85 mm Hg. Recent plasma glucose levels have ranged from 150 to 220 mg/dL [70–99].

Laboratory studies:

- Hemoglobin A1C: 8% [4.0%–5.6%]
- Serum creatinine: 0.83 mg/dL [0.7–1.5]
- Urine microalbumin-to-creatinine ratio: 60 mg/g [less than 30]

You advise the patient that the new class of hypoglycemic agents is associated with an increased risk of urinary tract infection.

You also should inform the patient that the FDA has issued a warning about which of the following serious adverse effects of these new medications?

(A) Acute kidney injury
(B) Hypoglycemia
(C) Lactic acidosis
(D) Diabetic ketoacidosis
23

Which of the following was approved in 2015 by the U.S. Food and Drug Administration (FDA) and is now available for the treatment of dialysis-related amyloidosis?

(A) Adalimumab
(B) Rituximab
(C) Plasma exchange
(D) Beta_2-microglobulin apheresis
(E) Hematopoietic stem cell transplantation
A 48-year-old white woman who has systemic lupus erythematosus is found to have proteinuria. Renal biopsy shows class 4 proliferative lupus glomerulonephritis. She is treated with glucocorticoids and cyclophosphamide, with improvement in serum creatinine and urine protein-to-creatinine ratio. She is started on mycophenolate mofetil for maintenance therapy, but after one month the medication is discontinued because of intolerable gastrointestinal adverse effects.

Which of the following alternative medications would provide the best benefit in terms of preservation of renal function and avoidance of renal flares, with the lowest adverse effect profile?

(A) Azathioprine
(B) Cyclophosphamide
(C) Cyclosporine
(D) Tacrolimus
(E) Prednisone
<table>
<thead>
<tr>
<th></th>
<th>Home blood pressure (mm Hg)</th>
<th>Office blood pressure (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient A</td>
<td>122/82</td>
<td>138/88</td>
</tr>
<tr>
<td>Patient B</td>
<td>122/84</td>
<td>156/92</td>
</tr>
<tr>
<td>Patient C</td>
<td>148/92</td>
<td>126/84</td>
</tr>
<tr>
<td>Patient D</td>
<td>148/92</td>
<td>162/90</td>
</tr>
</tbody>
</table>

Which of the following patients has masked hypertension?

(A) Patient A  
(B) Patient B  
(C) Patient C  
(D) Patient D
In hemodialysis patients, administration of cinacalcet has been shown to significantly reduce the incidence of which of the following?

(A) Calcific uremic arteriolopathy
(B) Peripheral vascular disease
(C) Adynamic bone disease
(D) Myocardial infarction
(E) Death from cardiovascular causes
A 45-year-old woman comes to you for evaluation of new-onset leg edema. Five years ago, the patient was found to have seropositive rheumatoid arthritis, which has been well controlled with nonsteroidal anti-inflammatory drugs, methotrexate, and etanercept.

The patient’s current weight is 68.0 kg (149.8 lb), which is a 5.0-kg (11.0-lb) increase over the past six months. On physical examination, she is afebrile; blood pressure is 145/90 mm Hg. The examination is notable for mild synovitis of the elbows, wrists, and knees and pretibial pitting edema (3+). There is no rash.

Laboratory studies:

- Hemoglobin: 11.0 g/dL [12–16]
- Serum creatinine: 1.13 mg/dL [0.7–1.5] (baseline: 0.91 mg/dL)
- Serum albumin: 3.0 g/dL [3.5–5.5]
- Serum complements: C3 48 mg/dL [100–233], C4 12 mg/dL [14–48]
- Antinuclear antibodies: 1:80 [1:40 or less]
- Urine protein-to-creatinine ratio: 5.3 mg/mg [less than 0.2]
- Urinalysis: Specific gravity 1.008 [1.002–1.030], Blood 2+, Albumin 3+, Microscopy: Lipiduria and many dysmorphic RBCs

Which of the following is the most likely cause of this patient’s new symptoms?

(A) Rheumatoid vasculitis
(B) Secondary amyloidosis
(C) Lupus-like autoimmune nephritis
(D) IgA nephropathy
A 51-year-old man who has a long history of poorly controlled type 2 diabetes mellitus was found to have hepatitis C five years ago. During the past year, his serum creatinine level has increased from 1.22 to 2.13 mg/dL [0.7–1.5]. At his health evaluation today, he is asymptomatic. Current medications are amlodipine and metformin.

On physical examination, blood pressure is 150/90 mm Hg; the examination is otherwise normal.

Laboratory studies:

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin</td>
<td>9.8 g/dL</td>
</tr>
<tr>
<td>Hemoglobin A1c</td>
<td>9.5% [4.0%–5.6%]</td>
</tr>
<tr>
<td>Blood urea nitrogen</td>
<td>26 mg/dL</td>
</tr>
<tr>
<td>Serum creatinine</td>
<td>2.12 mg/dL</td>
</tr>
<tr>
<td>Serum complements</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>160 mg/dL [100–233]</td>
</tr>
<tr>
<td>C4</td>
<td>31 mg/dL [14–48]</td>
</tr>
<tr>
<td>Serum free immunoglobulin light chain immunoassay</td>
<td></td>
</tr>
<tr>
<td>Kappa</td>
<td>55 mg/L [3.3–19.4]</td>
</tr>
<tr>
<td>Lambda</td>
<td>46 mg/L [5.7–26.3]</td>
</tr>
<tr>
<td>Urine protein-to-creatinine ratio</td>
<td>4.3 mg/mg [less than 0.2]</td>
</tr>
<tr>
<td>(last year: 1.8 mg/mg)</td>
<td></td>
</tr>
<tr>
<td>Urine protein electrophoresis</td>
<td>Polyclonal gamma spike</td>
</tr>
<tr>
<td>Hepatitis C virus RNA load</td>
<td>20,000 copies/mL</td>
</tr>
<tr>
<td>(last year: 15,000 copies/mL)</td>
<td></td>
</tr>
<tr>
<td>Urinalysis</td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>3+</td>
</tr>
<tr>
<td>RBCs</td>
<td>Rare</td>
</tr>
</tbody>
</table>

Which of the following is the most likely explanation of the decrease in this patient’s glomerular filtration rate over the past year?

(A) Amyloidosis
(B) Diabetes mellitus
(C) Hepatitis C
(D) Multiple myeloma
You are approached by the practice manager to select patient education materials on chronic kidney disease for your multidisciplinary practice.

Which of the following would be the best choice of patient education materials for your practice?

(A) Patient-centered articles at the sixth grade reading level or lower
(B) Articles by patients posted on the internet
(C) Articles endorsed by national foundations and the National Institutes of Health
(D) Well-referenced review articles by experts in the field
(E) Brochures provided by national dialysis services
30

Which of the following renal adverse events is most commonly seen with systemic bevacizumab therapy?

(A) Acute tubular necrosis
(B) Acute interstitial nephritis
(C) Sterile pyuria
(D) Proteinuria