Webinar

- Information re: 2016 clin path exam
  - Not about the redesign process
  - Anatomic webinar = December 16th
Webinar

- In lieu of review at ACVP meeting
- Format will be slightly different
  - Cannot show as many examples
  - Q&A session at end
- Being recorded
  - Webinar recording and ppt will be on ACVP website for review
2015 Clin Path EC

- Darren Wood, U of Guelph (chair)
- Elena Gorman, Oregon State
- Kirstin Barnhart, Abbvie
- Julie Webb, Idexx
- Andrea Bohn, CSU
- Ryan Dickinson, U of Saskatchewan
- Katie Boes, VA Tech
- Britton Grasperge, LSU
- Mehrdad Ameri, Charles River
2016 Clin Path EC

- Julie Webb, Idexx (chair)
- Elena Gorman, Oregon State
- Darren Wood, U of Guelph
- Andrea Bohn, CSU
- Ryan Dickinson, U of Saskatchewan
- Amy Warren, U of Calgary
- Melinda Camus, UGA
- Angela Royal, U of Missouri
- Theresa Rizzi, OK State
ACVP Certifying Exam (2016)

- Two phase exam
- Phase I
  - Formerly known as General Pathology
- Phase II
  - Hematology
  - Cytology and Surgical Pathology
  - Biochemistry
Phase I (General Pathology)

- 100 MCQs covering general pathology
  - NO species-specific questions
- Computer-based, Castle testing centers
- March 10\(^{th}\), 2016
- Eligible after 12 months of training
- MUST pass to proceed to Phase II
  - Can take and pass in same year as Phase II
  - Cut-score = 62\%, pass rate in 2015 = 87\%
Phase I (Gen Path) MCQs

- A morphologic feature of autophagy is:
  A. Organelle swelling
  B. Nuclear fragmentation
  C. Pericellular neutrophils
  D. Cytoplasmic intravacuolar whorls
The classical pathway of the complement cascade is activated when IgM binds:

A. C1q
B. C1r
C. C1s
D. C3b
Phase I (Gen Path) MCQs

Which is responsible for T lymphocyte anergy by blocking IL-2 production?
A. Fas
B. B7-1
C. CD28
D. CTLA-4
Phase I (Gen Path) MCQs

- Which reaction protects cells from free radical damage?
  A. Fenton
  B. NADPH redox
  C. Myeloperoxidase
  D. Peroxisome catalase
Phase II

- Three sections
  - Pass/fail each section
  - Cut-scores = 60-62%
- Hand-written
- Scheman Center, Iowa State U., Ames
- September 13^{th} and 14^{th}, 2016
- Eligible after 36 months of training
Phase II Clinical Pathology

- Hematology
- Cytology and Surgical Pathology (CSP)
- Biochemistry
Phase II Clinical Pathology

• **Hematology**
  – Glass slides (10)
  – Projected images (~25-30)
  – Multiple choice questions (40)

• **Cytology and Surgical Pathology (CSP)**
  – Glass slides (15)
  – Projected images (~35-40)
  – Multiple choice questions (25)

• **Biochemistry**
  – Essays (4)
  – Multiple choice questions (50)
Phase II Clinical Pathology

- All sections contain a mixture of neoplastic, inflammatory and other conditions

- Questions in all sections come from a variety of species
  - Dog, cat, horse, cow, other ruminants, lab animals, birds, exotics…
Phase II Clinical Pathology

- **Hematology**
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  - Multiple choice questions (25)

- **Biochemistry**
  - Essays (4)
  - Multiple choice questions (50)
Multiple Choice Questions

- Simple-type MCQs
  - Four choices (A-D)
  - One best answer
  - Bubble sheet

- Not tricks
  - Thorough screening process before and after exam
Multiple Choice Questions

- Knowledge-based
- Interpretation-based
  - Data set, tables, graphs, diagrams
  - Most likely diagnosis, best interpretation
MCQ - Hematology

- Fetal hemoglobin is present at birth in:
  A. Cats
  B. Dogs
  C. Birds
  D. Cows
MCQ - Hematology

In cats, prolonged aPTT and normal PT without a bleeding tendency occurs with deficiency of:
A. Factor IX
B. Factor XI
C. Factor VII
D. Factor XII
In a canine cerebrospinal fluid sample, the presence of extracellular myelin-like material is most likely associated with:

A. Necrosis
B. Neoplasia
C. Inflammation
D. Sampling artifact
In feline papillomavirus-associated squamous cell carcinomas, which protein has increased expression?

A. p16
B. p21
C. p53
D. pRb
## MCQ - Biochemistry

**Laboratory results from an African Grey parrot**

<table>
<thead>
<tr>
<th></th>
<th>R. I.</th>
<th>Patient (Baseline)</th>
<th>Patient (3 hr H₂O dep)</th>
<th>Patient (vasopressin)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sodium</strong></td>
<td>134-152</td>
<td>159</td>
<td>159</td>
<td>-</td>
</tr>
<tr>
<td><strong>Glucose</strong></td>
<td>6-9</td>
<td>13</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>USG</strong></td>
<td>1.005 – 1.020</td>
<td>1.003</td>
<td>1.003</td>
<td>1.020</td>
</tr>
<tr>
<td><strong>Plasma Osmolality</strong></td>
<td>299-313</td>
<td>327</td>
<td>340</td>
<td>312</td>
</tr>
</tbody>
</table>

Results are most consistent with:
A: Diabetes mellitus
B: Medullary washout
C: Psychogenic polydipsia
D: Central diabetes insipidus
What is plotted on the x-axis and y-axis, respectively, in this Levey-Jennings plot?

A. Time and sensitivity
B. Speed and assay range
C. Precision and accuracy
D. Time and concentration
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  – Essays (4)
  – Multiple choice questions (50)
Images

- Hematology and CSP
- Projected
  - In auditorium
  - 1-2 minutes each
  - Once, and only once
- Short-answer questions
  - Identify (cell, structure, organism…), diagnosis, interpretation, significance, cause…
Images

- **Hematology**
  - Blood smears, bone marrow samples, other tests (Coombs, TEG...), cytograms, flow data, special/immuno stains, EMs...

- **CSP**
  - Cytology, histology, EMs, special stains, immunostain stains, flow cytometry, urine sediment...
Images

- Not tricks - but be thorough
- Be as definitive and specific as possible
- Alternate wording that demonstrates the same knowledge will be accepted when graded
Hematology Image Examples
Cytograms from Advia 120
What is the indicated by the circled regions?

Lipemia
Cat bone marrow section
Which cell line predominates?

Erythroid
Fish (koi) blood, transmission electron micrograph
Identify the indicated cell

Thrombocyte
Flow cytometry data of canine leukemic cells. What cell lineage is most likely?

Monocytic
CSP Image Examples
Periarticular swelling in an iguana.
Provide an interpretation

Gout
(uric acid crystals)
Cutaneous mass aspirate from a dog
What color does the indicated structure stain with Masson’s Trichrome?

Blue
Tissue from a dog
Identify the tissue
Name two components of the granules

Pancreas (exocrine)
Lipase, amylase, trypsinogen…
Nasal flush from a dog
Give diagnosis

Eucoleus (Capillaria)
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  – Multiple choice questions (25)

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  – Essays (4)
  – Multiple choice questions (50)
Glass Slides

- Hematology and CSP
- 1 slide = 1 page write-up
- Provided for you
  - Species, sample type, lesion location
- You provide (point form or paragraph)
  - Description
  - Interpretation
1. Sheep blood smear
   Morphologic Description:

   Interpretation:

2. Cat, pleural fluid, cytospin
   Morphologic Description:

   Interpretation:
Glass Slides

- Timing = 12 minutes per slide
- Total points per case = 20
  - Description (12-14)
  - Interpretation (6-8)
Hematology – Glass Slides

- 10 slides, 2 hours = 12 minutes/slide
- On average
  - 7 blood smears
  - 3 bone marrows (aspirate or section)
Blood Smears

- **Description**
  - RBCs, WBCs, Platelets – mention all three, even if normal (density/numbers, cell morphology)
  - Extracellular material, inclusions, organisms…
  - If neoplastic cells or organisms, describe them in sufficient detail using proper terminology
    - Size, shape, colour, nuclei, nucleoli, identifying features…
Blood Smears

- Description (cont’d)
  - Density/number descriptors can be qualitative (mild, marked) as opposed to quantitative (PCV ~20%) 
  - WBC descriptors can be qualitative (mostly segmented neutrophils with fewer…) as opposed to quantitative (85% neutrophils)
Blood Smears

- **Interpretation**
  - RBCs, WBCs, Platelets – mention all three, even if normal
  - An interpretation is NOT just a repeat or summary of your description (see next slide)
  - Likely causes and/or additional tests (to confirm your dx, distinguish between ddx) also go here
  - Be as definitive and specific as possible
Blood Smears

**NO, not an interpretation**
- Anemia with marked polychromasia and many Heinz bodies
- Leukocytosis with segs, many bands and toxic change

**YES, an interpretation**
- Regenerative anemia due to oxidative damage/hemolysis (likely causes = …)
- Inflammatory leukogram
Cat blood smear
Description

- **Background**
  - Basophilic/crescents

- **RBCs**
  - Decreased
  - No polychromasia
  - Morphology WNL

- **Platelets**
  - Mild decrease
  - Normal morphology
Description

- **WBCs**
  - Markedly increased
  - Mostly atypical cells
    - Large
    - Basophilic cytoplasm
    - Variable nuclei (round, bilobed, binucleate, micro or satellite nuclei)
    - Finely stippled chromatin
    - Prominent nucleolus
  - Few segmented neutrophils, small lymphocytes and rare monocytes
Interpretation

- Hematopoietic neoplasm
  - Ddx = acute leukemia and lymphoma
  - Flow cytometry, ICC, cytochemical stains
  - FeLV testing
- Non-regenerative anemia and thrombocytopenia
  - Myelophthisis most likely
<table>
<thead>
<tr>
<th>Cat Blood Smear (Description)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background</strong></td>
<td></td>
</tr>
<tr>
<td>Basophilic, crescents or proteinaceous</td>
<td>1</td>
</tr>
<tr>
<td><strong>RBCs</strong></td>
<td></td>
</tr>
<tr>
<td>Decreased</td>
<td>1</td>
</tr>
<tr>
<td>No polychromasia</td>
<td>1</td>
</tr>
<tr>
<td><strong>Platelets</strong></td>
<td></td>
</tr>
<tr>
<td>Decreased</td>
<td>1</td>
</tr>
<tr>
<td><strong>WBCs</strong></td>
<td></td>
</tr>
<tr>
<td>Marked (1) increase (1)</td>
<td>2</td>
</tr>
<tr>
<td>Mostly atypical/immature/neoplastic</td>
<td>1</td>
</tr>
<tr>
<td>-Large</td>
<td>1</td>
</tr>
<tr>
<td>-Basophilic cytoplasm</td>
<td>1</td>
</tr>
<tr>
<td>-Variable nuclei (mention at least two of indented, bilobed, binucleate, micro/satellite nuclei)</td>
<td>2</td>
</tr>
<tr>
<td>-Nucleolus</td>
<td>1</td>
</tr>
<tr>
<td>Cat Blood Smear (Interpretation)</td>
<td>Points</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Hematopoietic neoplasia</td>
<td>2</td>
</tr>
<tr>
<td>-Differentials include acute leukemia (1) and lymphoma (1)</td>
<td>2</td>
</tr>
<tr>
<td>-Cell characterization (flow, ICC or cytochemistry)</td>
<td>1</td>
</tr>
<tr>
<td>-FeLV testing</td>
<td>1</td>
</tr>
<tr>
<td>Non-regenerative anemia and thrombocytopenia</td>
<td>1</td>
</tr>
<tr>
<td>-myelophthisis</td>
<td>1</td>
</tr>
</tbody>
</table>

Note for grading keys:
All grading keys contain flexibility to accommodate the different ways that different people say the same thing (alternate wording that demonstrates the same knowledge will be accepted)
Bone Marrows
Candidate Performance on Glass Slides

Best

Worst
Bone Marrows

- **Description**
  - Cellularity, particles, iron
  - Mention all three lines (even if normal)
    - Extent? Maturation? Morphology?
  - M:E ratio
  - Lymphocytes, plasma cells, macrophages
  - Atypical cells, organisms, matrix or extracellular material
  - Bony changes (histology)
Bone Marrows

- Interpretation
  - Mention all three lines and any other diagnosis/abnormality
  - Interpretation without CBC data?
    - Hyperplasia/hypoplasia will be obvious
    - Left shifts, dysplasia or morphologic changes
    - Neoplasm, inflammation/organism, histologic changes...
Dog bone marrow section
Description

- Highly cellular
- Small amount iron
- Many megakaryocytes
  - All stages, morphology WNL
- Erythroid
  - Mostly mature (metarubricytes, rubricytes)
  - Morphology WNL
- Myeloid
  - Mostly mature (segs), morphology WNL
- M:E ~ 1:2
- Lymphocytes, plasma cells, macrophages few
Description

- Focal region of cells
  - Arranged in sheets
  - Round to spindle
  - Eosinophilic cytoplasm
  - Round to oval nucleus
  - Stippled chromatin
  - Occ. cell displays marked pleomorphism (very large, macronucleus)
  - Binucleation and mitotic figures
Interpretation

- Malignant neoplasm
  - Likely histiocytic sarcoma
  - IHC to confirm (MHCII, CD18, CD204…)
- Megakaryocytes unremarkable to hyperplastic
- Erythroid unremarkable
- Myeloid unremarkable
<table>
<thead>
<tr>
<th>Dog bone marrow section (Description)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly cellular</td>
<td>1</td>
</tr>
<tr>
<td>Small amount of iron</td>
<td>1</td>
</tr>
<tr>
<td>M:E approx 1:2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Megakaryocytes</strong></td>
<td></td>
</tr>
<tr>
<td>Many</td>
<td>1</td>
</tr>
<tr>
<td>All stages present or normal morphology</td>
<td>1</td>
</tr>
<tr>
<td><strong>Erythroid (describe at least two)</strong></td>
<td></td>
</tr>
<tr>
<td>Complete, orderly/synchronous (mostly mature), normal morphology/no dysplasia</td>
<td>2</td>
</tr>
<tr>
<td><strong>Myeloid (describe at least two)</strong></td>
<td></td>
</tr>
<tr>
<td>Complete, orderly/synchronous (mostly segs), normal morphology/no dysplasia</td>
<td>2</td>
</tr>
<tr>
<td>Dog bone marrow section (Description)</td>
<td>Points</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Neoplastic cells</td>
<td></td>
</tr>
<tr>
<td>-focal region</td>
<td>1</td>
</tr>
<tr>
<td>-arranged in sheets</td>
<td>1</td>
</tr>
<tr>
<td>-describe at least two of: shape, eosinophilic cytoplasm, round to oval nucleus, stippled chromatin</td>
<td>1</td>
</tr>
<tr>
<td>-marked pleomorphism noted (very large cell or macronucleus)</td>
<td>1</td>
</tr>
<tr>
<td>-binucleated or mitotic figures</td>
<td>1</td>
</tr>
<tr>
<td>Dog Bone Marrow Section (Interpretation)</td>
<td>Points</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Malignant neoplasm</td>
<td>2</td>
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<tr>
<td>-primary differential = histiocytic sarcoma</td>
<td>2</td>
</tr>
<tr>
<td>-confirm with IHC (MHCII, CD18, CD204…)</td>
<td>1</td>
</tr>
<tr>
<td>Erythroid, myeloid and megakaryocytic lines unremarkable (accept myeloid hyperplasia)</td>
<td>1</td>
</tr>
</tbody>
</table>
CSP – Glass Slides

- 15 slides, 3 hours = 12 minutes per slide
- On average
  - 12 cytology slides
  - 3 histology slides
CSP – Glass Slides

Description

- Cellularity, background (cytos)
- Location, arrangement (histos)
- Cell populations (resident, inflammatory, neoplastic), organisms, extracellular material
- If neoplastic cells or pathologic organism, describe them in sufficient detail using proper terminology
  - Size, shape, colour, nuclei, nucleoli, identifying features…
CSP – Glass Slides

- **Interpretation**
  - Diagnosis (or differential diagnoses)
  - Additional tests (to refine your dx, differentiate between ddx...)
  - Be as definitive/specific as possible
    - Most slides have a definitive diagnosis or very limited set of reasonable differential diagnoses
    - Listing a long set of unlikely differentials will not get you the points
Cat, conjunctival mass, imprints
Cat, conjunctival mass, imprints
Cat, conjunctival mass, imprints
Description

- Highly cellular
- Small amount of blood, eosinophilic stippled background
- Squamous (conjunctival) epithelial cells
  - Clusters/sheets
  - Mild basophilia and anisocytosis
  - Few binucleated cells
- Mixed inflammatory population
  - Mostly non-degenerate neutrophils, fewer macrophages and small lymphocytes
  - Few bi- and multi-nucleated macrophages
Description

- **Organism**
  - Numerous
  - Within neutrophils and macrophages
  - Yeast
  - Round to oval to cigar-shaped
  - 3-5um in size
  - Blue-purple cytoplasm, thin clear wall or halo
Interpretation

- Pyogranulomatous inflammation with Sporothrix schenckii
- Hyperplastic epithelium
<table>
<thead>
<tr>
<th>Cat conjunctival mass (Description)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly cellular</td>
<td>1</td>
</tr>
<tr>
<td>Small amount blood or stippled eosinophilic background</td>
<td>1</td>
</tr>
<tr>
<td><strong>Epithelium</strong></td>
<td></td>
</tr>
<tr>
<td>Clusters or sheets</td>
<td>1</td>
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<tr>
<td>Basophilia, anisocytosis or binucleate</td>
<td>2</td>
</tr>
<tr>
<td><strong>Inflammation</strong></td>
<td></td>
</tr>
<tr>
<td>Mostly non-degenerate neutrophils</td>
<td>1</td>
</tr>
<tr>
<td>Fewer small lymphocytes and macrophages</td>
<td>1</td>
</tr>
<tr>
<td>Bi and multinucleated macrophages</td>
<td>1</td>
</tr>
<tr>
<td>Cat conjunctival mass (Description)</td>
<td>Points</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td><strong>Organism</strong></td>
<td></td>
</tr>
<tr>
<td>Numerous/many</td>
<td>1</td>
</tr>
<tr>
<td>In neutrophils and macrophages</td>
<td>1</td>
</tr>
<tr>
<td><strong>Yeast</strong></td>
<td></td>
</tr>
<tr>
<td>Round, oval to cigar-shaped (mention at least two)</td>
<td>1</td>
</tr>
<tr>
<td>3-5um</td>
<td>1</td>
</tr>
<tr>
<td>Blue to purple cytoplasm, clear halo/wall</td>
<td>1</td>
</tr>
<tr>
<td>Cat conjunctival mass (Interpretation)</td>
<td>Points</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Pyogranulomatous inflammation</td>
<td>2</td>
</tr>
<tr>
<td>Sporothrix (2) schenckii (1)</td>
<td>3</td>
</tr>
<tr>
<td>Hyperplastic epithelium</td>
<td>1</td>
</tr>
</tbody>
</table>
Phase II Clinical Pathology

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  - Essays (4)
  - Multiple choice questions (50)
Biochemistry Essays

- 4 cases, approx. 2 hours = 30 min each
- 20 points/case
- Provided to you
  - Species
  - Case data (CBC, chemistry, +/- UA, +/- other)
  - 5 pages of blank paper
- You provide (point form or paragraph)
  - Explanation for the laboratory abnormalities
  - Summary of the case and ancillary tests
Biochemistry Essays

- Approach to a case
  - Identify abnormalities and group where appropriate (eg. urea and creatinine, proteins…)
  - For each abnormality (or group of abnormalities), provide an explanation, or a limited set of likely explanations, for the abnormality in this patient
  - Do not list all possible/general causes
  - An “explanation” may be a specific disease (Addison’s) or a general mechanism (vomiting)
Biochemistry Essays – Approach

Thrombocytosis

No, do not list all possible reasons

- Physiologic
- Reactive/inflammatory
- Recent splenectomy
- Reactive/inflammatory
- Cushings
- Iron deficiency
- Essential thrombocythemia

Yes, provide the likely reason(s)

- Reactive/inflammatory
- Cushings
Biochemistry Essays – Approach
Titrational Metabolic Acidosis

No, do not list all possible reasons
- Ketoacids
- Uremic acids
- Lactic acid
- Ethylene glycol

Yes, provide the likely reason(s)
- Uremic acids
Biochemistry Essays

Approach to a case (cont’d)

- All abnormalities should be addressed
- Some normal values may also be important (normal creatinine with high urea)
- No right or wrong order to write-up your case
  - CBC – chem – UA – other
  - Major findings – minor findings
- After addressing abnormalities, summarize
Biochemistry Essays

Summary

- Overall interpretation
- Diagnosis(es) for the patient
- May include specific diseases (Lepto) and more generic entities (nephrotic syndrome)
- May be some overlap between your summary and your earlier explanations
- Ancillary tests (to confirm, refine or further investigate) should be provided
## Adult dog

<table>
<thead>
<tr>
<th>Hematology (Units)</th>
<th>Patient</th>
<th>Flag</th>
<th>Reference Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematocrit (%)</td>
<td>47</td>
<td></td>
<td>39 – 57</td>
</tr>
<tr>
<td>Hemoglobin (g/dL)</td>
<td>16.3</td>
<td></td>
<td>14 – 21</td>
</tr>
<tr>
<td>RBC (x 10^6/µL)</td>
<td>6.7</td>
<td></td>
<td>5.6 – 8.4</td>
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<tr>
<td>MCV (fL)</td>
<td>70</td>
<td></td>
<td>61 – 73</td>
</tr>
<tr>
<td>MCHC (g/dL)</td>
<td>35</td>
<td></td>
<td>34 – 38</td>
</tr>
<tr>
<td>RBC Morphology</td>
<td>Within normal limits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WBC (x 10^3/µL)</td>
<td>14.7</td>
<td>H</td>
<td>5.0 – 14.0</td>
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<tr>
<td>Segmented neutrophils (x 10^3/µL)</td>
<td>13.0</td>
<td>H</td>
<td>2.6 – 10.0</td>
</tr>
<tr>
<td>Band neutrophils (x 10^3/µL)</td>
<td>0.3</td>
<td>H</td>
<td>0.0 – 0.2</td>
</tr>
<tr>
<td>Lymphocytes (x 10^3/µL)</td>
<td>0.7</td>
<td></td>
<td>0.7 – 4.3</td>
</tr>
<tr>
<td>Monocytes (x 10^3/µL)</td>
<td>0.6</td>
<td></td>
<td>0.1 – 0.9</td>
</tr>
<tr>
<td>Eosinophils (x 10^3/µL)</td>
<td>0.1</td>
<td></td>
<td>0.1 – 1.7</td>
</tr>
<tr>
<td>WBC Morphology</td>
<td>Few Dohle bodies</td>
<td></td>
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</tr>
<tr>
<td>Platelets (x 10^3/µL)</td>
<td>626</td>
<td>H</td>
<td>175 – 500</td>
</tr>
<tr>
<td>Plasma protein (g/dL)</td>
<td>8.2</td>
<td>H</td>
<td>5.6 – 8.0</td>
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</table>
## Serum Biochemical Profile

<table>
<thead>
<tr>
<th></th>
<th>Patient</th>
<th>Flag</th>
<th>Reference Interval</th>
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<tbody>
<tr>
<td>Na (mmol/L)</td>
<td>148</td>
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<td>141 - 150</td>
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<tr>
<td>K (mmol/L)</td>
<td>4.1</td>
<td></td>
<td>3.9 – 5.3</td>
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<tr>
<td>Cl (mmol/L)</td>
<td>116</td>
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<td>109 - 119</td>
</tr>
<tr>
<td>Total CO2 (mmol/L)</td>
<td>5</td>
<td>L</td>
<td>19 – 30</td>
</tr>
<tr>
<td>Anion Gap (mmol/L)</td>
<td>30</td>
<td>H</td>
<td>15 – 25</td>
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<tr>
<td>Calcium (mg/dL)</td>
<td>10.8</td>
<td></td>
<td>9.7 – 12.3</td>
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<tr>
<td>Phosphorus (mg/dL)</td>
<td>15.0</td>
<td>H</td>
<td>2.2 – 7.9</td>
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<tr>
<td>Urea (mg/dL)</td>
<td>110</td>
<td>H</td>
<td>7.0 – 32</td>
</tr>
<tr>
<td>Creatinine (mg/dL)</td>
<td>4.6</td>
<td>H</td>
<td>0.5 – 1.5</td>
</tr>
<tr>
<td>Glucose (mg/dL)</td>
<td>130</td>
<td></td>
<td>67 - 132</td>
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<tr>
<td>Total Protein (g/dL)</td>
<td>7.5</td>
<td>H</td>
<td>4.8 – 6.9</td>
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<tr>
<td>Albumin (g/dL)</td>
<td>3.5</td>
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<td>2.3 – 3.9</td>
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<tr>
<td>Globulin (g/dL)</td>
<td>4.0</td>
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<td>2.2 – 3.5</td>
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<tr>
<td>CK (U/L)</td>
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<td>22 - 491</td>
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<tr>
<td>AST (U/L)</td>
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<td>21 - 53</td>
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<tr>
<td>ALT (U/L)</td>
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<td>14 – 87</td>
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<td>ALP (U/L)</td>
<td>1486</td>
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<td>20 – 157</td>
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<td>GGT (U/L)</td>
<td>33</td>
<td>H</td>
<td>5 – 16</td>
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<tr>
<td>Total Bilirubin (mg/dL)</td>
<td>0.3</td>
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<td>0.1 – 0.8</td>
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<tr>
<td>Cholesterol (mg/dL)</td>
<td>&gt;650</td>
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<td>149 - 319</td>
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<tr>
<td>Triglycerides (mg/dL)</td>
<td>131</td>
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<td>32 - 190</td>
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<tr>
<td>Urinalysis</td>
<td>Patient</td>
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<td>Collection Method</td>
<td>Cystocentesis</td>
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<td>Color</td>
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<td>Clarity</td>
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<td>Specific gravity</td>
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<td><strong>Reagent Strip</strong></td>
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<tr>
<td>pH</td>
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<tr>
<td>Protein</td>
<td>3+</td>
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<tr>
<td>Glucose</td>
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<tr>
<td>Ketones</td>
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<tr>
<td>Bilirubin</td>
<td>Negative</td>
<td></td>
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</tr>
<tr>
<td>Blood</td>
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<tr>
<td><strong>Sediment Exam</strong></td>
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<tr>
<td>RBC (per hpf)</td>
<td>Rare (&lt;1)</td>
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<tr>
<td>WBC (per hpf)</td>
<td>1-5</td>
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<tr>
<td>Epithelial cells</td>
<td>Few squamous and transitional</td>
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<tr>
<td>Casts</td>
<td>None</td>
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</tr>
<tr>
<td>Crystals</td>
<td>None</td>
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<td></td>
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<tr>
<td>Bacteria</td>
<td>Many cocci</td>
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<tr>
<td>Thromboelastography</td>
<td>Patient</td>
<td>Flag</td>
<td>Reference Interval</td>
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<tr>
<td>---------------------</td>
<td>---------</td>
<td>------</td>
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</tr>
<tr>
<td>R (min)</td>
<td>5.8</td>
<td></td>
<td>3 – 9</td>
</tr>
<tr>
<td>K (min)</td>
<td>1.4</td>
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<td>1 – 6</td>
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<tr>
<td>α (degrees)</td>
<td>70.5</td>
<td>H</td>
<td>34 – 74</td>
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<tr>
<td>MA (mm)</td>
<td>75.5</td>
<td>H</td>
<td>40 – 70</td>
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<tr>
<td>G (d/sec)</td>
<td>15.4</td>
<td>H</td>
<td>3.2 – 10.1</td>
</tr>
</tbody>
</table>
Adult Dog – Case Write-up

- **CBC**
  - Leukocytosis due to neutrophilia and left shift = inflammatory leukogram
    - Source of inflammation may be kidneys or liver
  - Thrombocytosis
    - Likely reactive/inflammatory
    - Could also be Cushings
Adult Dog – Case Write-up

Chemistry

- Low TCO2 with high AG = titration-type metabolic acidosis
  - Most likely uremic acids
- Increased urea, creat and P = azotemia, reduced GFR
  - USG low (1.010) so consistent with renal injury
- Increased TP and globulins
  - = inflammatory hyperglobulinemia (also has inflammatory leukogram)
Adult Dog – Case Write-up

- Chemistry
  - Markedly increased ALKP with mildly to moderately increased ALT and GGT. Bili N.
    - Most consistent with steroid induction (exogenous or Cushings)
    - Cannot rule out intrahepatic/post-hepatic disease (e.g. cholangiohepatitis, Lepto, pancreatitis) but would expect bili to be increased too
Adult Dog – Case Write-up

- Chemistry
  - Marked increased cholesterol
    - Likely Cushings or cholestasis based on other liver enzymes
    - Also consider PLN/nephrotic syndrome
Adult Dog – Case Write-up

- **UA**
  - 3+ protein in 1.010 urine, likely significant protein loss through glomerulus even though albumin normal
  - Many cocci in cysto sample = UTI with minimal inflammatory response (1-5 WBC)

- **TEG**
  - Increased MA and G = hypercoagulable
    - Suspect Cushings and/or PLN
Adult Dog – Case Summary

- Renal insufficiency, urinary tract infection and likely PLN
  - UTI could be pyelonephritis or lower (bladder)
  - Recommend urine culture and UPC
  - Other tests to consider = AUS, renal FNA, Lepto, blood pressure

- Likely Cushings
  - LDDS or ACTH stim to confirm
<table>
<thead>
<tr>
<th>Adult Dog Chemistry</th>
<th>Points</th>
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<tbody>
<tr>
<td>Inflammatory leukogram</td>
<td>1</td>
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<tr>
<td>Thrombocytosis</td>
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<tr>
<td>- reactive/inflammatory</td>
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</tr>
<tr>
<td>- Cushings/hyperadrenocorticism</td>
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<tr>
<td>Metabolic acidosis</td>
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<tr>
<td>- titrational</td>
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<tr>
<td>- uremic acids</td>
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<tr>
<td>Renal azotemia</td>
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<tr>
<td>Inflammatory hyperglobulinemia</td>
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<tr>
<td>Adult Dog Chemistry</td>
<td>Points</td>
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<tr>
<td>----------------------------------------------------------</td>
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<tr>
<td>ALKP, ALT and GGT</td>
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<tr>
<td>- Steroid or Cushings</td>
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<tr>
<td>- Other hepatic/post hepatic cause</td>
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<tr>
<td>Cholesterol</td>
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<td>- Cushings or cholestasis</td>
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<tr>
<td>- protein losing nephropathy</td>
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<td>Glomerular proteinuria</td>
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<td>Urinary tract infection</td>
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<tr>
<td>- Pyelonephritis vs lower/bladder</td>
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<tr>
<td>Hypercoagulable TEG</td>
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<tr>
<td>- Cushings</td>
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<tr>
<td>- PLN</td>
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<tr>
<td>Adult Dog Chemistry - Summary</td>
<td>Points</td>
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<tr>
<td>---------------------------------------------------------------------------------------------</td>
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<tr>
<td>Renal disease (insufficiency, urinary tract infection and PLN/glomerular disease)</td>
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<tr>
<td>- Urine culture</td>
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<td>- UPC ratio</td>
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<tr>
<td>- Other testing (AUS, renal FNA, Lepto, BP…)</td>
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<tr>
<td>Likely/suspect Cushings</td>
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<tr>
<td>- LDDS or ACTH stim</td>
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</table>
Questions?
Happy Holidays!