A 10 year old female neutered Border Collie was presented to the R(D)SVS Canine Medicine Service for investigation of lethargy, inappetance and weight loss. She had been inappetant for approximately 6 weeks and weight had decreased from 21kg to 19.1kg over this time. The owners reported a slight increase in thirst with no increase in urination. Previous history included chronic osteoarthritis and atopy for which NSAIDs and prednisolone were intermittently administered. No medications had been given for these problems for several weeks.

On physical examination the dog was quiet, alert and responsive. Body condition score was 3/9. She was estimated 5% dehydrated based on tacky mucous membranes. Oral examination revealed dental tartar and gingivitis. Mucous membranes were pink with capillary refill time less than 2 seconds. Peripheral lymph nodes were within normal limits. Heart rate was 104 bpm with an adequate quality matched pulse. No murmurs were auscultated. Respiratory rate was 20 with no abnormalities heard on auscultation of the lung fields. Abdominal palpation revealed no abnormalities, the bladder was relatively full. Rectal examination and anal glands were normal. Rectal temperature was 38.7C. There was alopecia and erythema of the skin on paws with saliva staining consistent with the long term allergic skin disease.

A blood sample for routine, haematology and serum biochemistry was obtained and urine by cystocentesis for urinalysis with results overleaf. The urine sample was also submitted for culture.
### Haematology

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBC</td>
<td>5.69</td>
<td>5.5 – 8.5 x10¹²/l</td>
</tr>
<tr>
<td>PCV</td>
<td>0.42</td>
<td>0.39 – 0.55 l/l</td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>14.3</td>
<td>12 – 18 g/dl</td>
</tr>
<tr>
<td>WBC</td>
<td>6.3</td>
<td>6 – 15 x10⁹/l</td>
</tr>
<tr>
<td>Neutrophils</td>
<td>4.2</td>
<td>3.6 – 12 x10⁹/l</td>
</tr>
<tr>
<td>Lymphocytes</td>
<td>1.1</td>
<td>0.7 – 4.8 x10⁹/l</td>
</tr>
<tr>
<td>Monocytes</td>
<td>0.3</td>
<td>0 – 1.5 x10⁹/l</td>
</tr>
<tr>
<td>Eosinophils</td>
<td>0.7</td>
<td>0 – 1 x10⁹/l</td>
</tr>
<tr>
<td>Platelets</td>
<td>252</td>
<td>200 – 500 x10⁹/l</td>
</tr>
</tbody>
</table>

### Biochemistry

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Protein</td>
<td>59.9</td>
<td>58 – 73 g/l</td>
</tr>
<tr>
<td>Albumin</td>
<td>33.6</td>
<td>26 – 35 g/l</td>
</tr>
<tr>
<td>Globulin</td>
<td>29.3</td>
<td>18 – 37 g/l</td>
</tr>
<tr>
<td>Bile Acids</td>
<td>3.2</td>
<td>0 – 7 µmol/l</td>
</tr>
<tr>
<td>Total Bilirubin</td>
<td>5.7</td>
<td>0 – 6.8 µmol/l</td>
</tr>
<tr>
<td>AP</td>
<td>71</td>
<td>20 – 60 U/l</td>
</tr>
<tr>
<td>ALT</td>
<td>44</td>
<td>21 – 102 U/l</td>
</tr>
<tr>
<td>Sodium</td>
<td>151</td>
<td>139 – 154 mmol/l</td>
</tr>
<tr>
<td>Chloride</td>
<td>113</td>
<td>99 – 115 mmol/l</td>
</tr>
<tr>
<td>Potassium</td>
<td>4.8</td>
<td>3.6 – 5.6 mmol/l</td>
</tr>
<tr>
<td>Calcium</td>
<td>3.02</td>
<td>2.3 – 3.0 mmol/l</td>
</tr>
<tr>
<td>Inorganic Phosphorus</td>
<td>1.98</td>
<td>0.9 – 2.0 mmol/l</td>
</tr>
<tr>
<td>Magnesium</td>
<td>1.02</td>
<td>0.7 – 1.2 mmol/l</td>
</tr>
<tr>
<td>Creatinine</td>
<td>305</td>
<td>40 – 132 µmol/l</td>
</tr>
<tr>
<td>Urea</td>
<td>30.9</td>
<td>1.7 – 7.4 nmol/l</td>
</tr>
<tr>
<td>Glucose</td>
<td>4.8</td>
<td>3 – 5 mmol/l</td>
</tr>
</tbody>
</table>

1) **What are your differential diagnoses for the raised urea and creatinine in this case?**

2) **What investigations would you perform?**
1) Differential Diagnoses chronic/subacute azotaemia

- Renal
  - Infectious
    - Bacterial pyelonephritis
    - Leptospirosis
    - Lyme disease
      - (leishmaniasis or borreliosis if history of travel)
  - Inflammatory/Immune-mediated disease
    - Glomerulonephritis/glomerulosclerosis
    - Renal Amyloidosis
    - Systemic lupus erythematosus
  - Obstructive
    - Renal or ureteral urolithiasis
    - Renal or ureteral neoplasia
    - Urinary tract rupture (less likely due to chronicity of clinical signs)
  - Congenital
    - Renal dysplasia – reported in many breeds
    - Glomerulopathy – reported in many breeds
    - Other familial/congenital diseases mostly breed specific and not reported in collies

- Vascular/Perfusion
  - Dehydration/hypovolaemia
  - Thrombosis/infarction
  - Hypotension
  - Hypertension
  - Vasculitis
  - Spay granuloma
  - Cardiac failure (unlikely based on physical examination)

- Metabolic
  - Hypercalcaemia
  - Hypoadrenocorticism
  - Pancreatitis

- Toxic
  - NSAIDs (for arthritis)
    - Adder venom, accidental ingestion (ethylene glycol, grapes and raisins, lillies, lead etc…….) (less likely due to subacute presentation)
2) Further Investigations

**Urine** was obtained by cystocentesis for analysis and culture
- Specific gravity was 1.015, pH was 10.0, bacterial rods and many triple phosphate crystals were seen on sediment examination.
- Urine protein to creatinine ratio was elevated at 1.1
- Urine culture was positive for Proteus mirabilis spp. sensitive to Amoxy/clav, Trim/sulphonamides, Cephalexin, Gentamicin and Enrofloxacin but resistant to Doxycycline.

**Ionised calcium** was 1.31 mmol/l (ref 1.16-1.33 mmol/l).
Therefore the high total calcium level was considered not to be clinically relevant and further investigation of hypercalcaemia not warranted. An increased total calcium concentration with normal or low ionized calcium is not uncommon with chronic renal dysfunction.

**Blood pressure** was moderately elevated at 165 mmHg.

**Abdominal ultrasonography** revealed markedly misshapen kidneys with hypergenicity of the cortices. Both had the appearance of ‘end-stage kidneys’. This could be as a result of chronic kidney disease but could also be secondary to previous toxic/infectious/inflammatory insult, or renal dysplasia. More definitive information on the aetiology of the kidney changes would require renal biopsy (declined in this case).
Subsequently the owners revealed the dog had experienced a previous episode of azotaemia following a urinary tract infection and NSAID administration when she was 9 months old.
Diagnosis

- *Proteus mirabilis* spp. urinary tract infection with high suspicion of pyelonephritis. The appearance of the kidneys evidences chronic renal disease, and therefore likely chronic renal insufficiency (IRS stage 3 with proteinuria and hypertension), and so this should be treated as a complicated urinary tract infection.

Treatment

- **Intravenous fluid therapy** for 24 hours calculated for rehydration (5% of 19.1kg = 955ml over 12 hours, plus twice maintenance @ 50ml/kg/24hr = 120ml/hr for 12 hours followed by 40ml/hr for 12 hours.

Recommendations for a complicated UTI are

- **Antibiosis** based on culture and sensitivity testing for a minimum of 4-6 weeks.
  - 250mg potentiated amoxicillin q.12 hours was prescribed.
- Urine should be obtained by cystocentesis 5-7 days following the start of treatment for sediment examination and repeat culture to confirm the effectiveness of the antibiotic chosen.
- Culture should be repeated before stopping antibiotics (sample 3-4 days before end of planned course)
- and again 10-14 days after the antibiotics are stopped to ensure the infection has been eliminated.

- **Benazepril** 0.5mg/kg q. 24 h for proteinuria and control of blood pressure
- **Ranitidine** 2ml/kg q. 12 hours in case of uraemic gastritis contributing to inappetance.
- **Combivit B complex** injection (2ml) as chronic renal insufficiency leads to loss of B vitamins in urine and potential deficiency
- **Prescription Diet** formulated for chronic renal insufficiency

Outcome

The dog was much brighter and ate 10/10 following fluid therapy. Azotaemia was improved (Urea 23.1 mmol/l, Creatinine 224 umol/l).

At recheck one week following discharge, she was still bright and eating well. Urine culture was negative, urine. Blood pressure was 155mg Hg. Urine SG was 10.15 and UPC was 0.8 indicating likely permanent (but not complete) loss of urine concentrating ability and a degree of ongoing proteinuria.

Discussion

In this case it was unclear whether a longstanding silent urinary tract infection was the primary cause of the renal disease or whether it was a secondary event and exacerbated long standing renal disease due to renal dysplasia or a previous renal insult. However the ultrasonographic appearance of the kidneys showed irreversible renal damage and the dog will need close monitoring and management for this even after the bacterial infection has been eliminated.

The case demonstrates the importance of integrating the findings from urinalysis, in particular sediment examination and bacterial culture, with information from diagnostic imaging for diagnosis, prognosis and optimal management for the patient. Without all the information, chronic renal failure with 'end-stage kidney' may have been diagnosed and the presence of a UTI missed, or an uncomplicated UTI diagnosed without recognising the chronic renal disease.

The ideal future management regime for this patient should be based on the clinical signs, and restaging of the chronic renal disease (creatinine level, proteinuria and hypertension)
once the antibiotic course is completed and the infection eliminated. In particular, the UPC ratio is unreliable in the face of a urinary tract infection.

Reference