what's the take-home?

INSIGHTS FROM CLINICAL CASES . PRESENTATION

# Feline Chronic Renal Failure

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A 15-year-old, male, neutered domestic shorthair cat presented with a 3-month history of polydipsia. The owners had noted some weight loss over the same period, but were primarily concerned about a decrease in the cat's appetite over the past week and that it seemed weak and lethargic.

Physical examination and test results (**Table**) revealed the following:

- Body condition score 2/5—underweight
- Dull hair coat
- Hydration status—slightly dehydrated (mucous membranes somewhat tacky)
- Systolic heart murmur loudest over the sternum on the left side (grade II/VI)
- Small and slightly irregular kidneys on palpation
- Urinary bladder—moderately full

**ASK YOURSELF. . .**

- **How would you classify the azotemia identified in this case? On what basis would you make this classification?**
- **What further routine diagnostic tests would you undertake? What is the justification for these tests?**

continues

**Diagnostic Testing**

| Type of Testing | Variable | Results | Range |
|---|---|---|---|
| Chemistry screen | Total protein (g/dl) | 8.2 | 5.5–8.0 |
| | Albumin (g/dl) | 3.3 | 2.4–4.3 |
| | Sodium (mEq/L) | 152 | 140–156 |
| | Potassium (mEq/L) | 2.8 | 3.5–5.5 |
| | Chloride (mEq/L) | 112 | 110–130 |
| | Calcium (mg/dl) | 10.7 | 9.0–11.0 |
| | Phosphate (mg/dl) | 11.7 | 2.17–5.75 |
| | Total $CO_2$ (mEq/L) | 13.0 | 14.0–23.0 |
| | Urea nitrogen (mg/dl) | 92.4 | 11–42 |
| | Creatinine (mg/dl) | 4.37 | 0.45–2.0 |
| | Glucose (mg/dl) | 140 | 65–105 |
| | Cholesterol (mg/dl) | 223 | 70–190 |
| | Alanine transaminase (IU/L) | 84 | 20–100 |
| | Alkaline phosphatase (IU/L) | 56 | 10–60 |
| | Total thyroxine (mg/dl) | 1.63 | 1.5–4.3 |
| Complete blood count | — | Within normal range | |
| | Hematocrit (%) | 33 | 27–48 |
| Urinalysis* (cystocentesis) | Urine specific gravity | 1.014 | — |
| | Protein | +2 | — |
| | Blood | +2 | — |
| | pH | 5.0 | — |

*The results of other dipstick tests were negative.

# INSIGHTS FROM CLINICAL CASES . DISCUSSION

## Interpretation

Azotemia indicates retention of nitrogenous waste products by the body and can be localized to:

- Prerenal (reduced GFR due to reduced renal blood flow and increased renal reabsorption of urea; secondary to hypovolemia and/or hypotension)
- Primary intrinsic renal (primary disease of the kidneys leading to loss of functioning nephrons and reduced GFR)
- Postrenal (leakage of urine into the peritoneal cavity or obstruction of the urinary tract).

## Intrinsic Renal Failure

In this case, azotemia probably resulted from primary intrinsic renal failure. No clinical signs suggest obstructive urinary tract disease leading to azotemia, and there is no history of blunt abdominal trauma. Abdominal radiography would help rule out bilateral ureteral obstruction as a cause of azotemia in this case (see **Additional Diagnostic Tests**). The cat does not have clinical signs of severe circulatory compromise leading to reduced GFR, although it is clinically dehydrated. The cat is producing inappropriately dilute urine, and thus is not able to respond to dehydration by conserving water and concentrating the urine.

Having determined that the patient is most likely to have renal azotemia, the clinician must then decide whether the condition is acute or chronic. It is important to recognize that none of the laboratory tests in this case can distinguish between a decompensated chronic case of renal failure and an acute case. The cat has become inappetent, weak, and lethargic over a few days before presentation, but several features suggest chronic kidney disease:

- History of weight loss and polydipsia for 3 months or more
- Small, shrunken, irregular kidneys
- Dull hair coat and low body condition score.

**DID YOU ANSWER. . .**

- **Azotemia indicates retention of nitrogenous waste products by the body and can be localized as prerenal, primary intrinsic renal, and postrenal.**
- **Urine sediment examination (+/– urine culture); assessment of urine protein excretion; measurement of arterial blood pressure; and diagnostic imaging of the kidneys and urinary tract (+/– renal biopsy).**

All these features suggest chronic kidney failure and recent decompensation. It cannot be determined whether decompensation is caused by an insult to the kidneys or intrinsic progressive renal injury.

## Further Diagnostic Tests

After identification of the case as decompensated chronic renal failure, further diagnostic tests should be aimed at identifying:

- A primary (and, it is hoped, treatable) extrinsic disease responsible for the episode of decompensation
- Complications of the uremic syndrome that lead to reduced quality of life and progressive renal injury toward end stage.

Hypokalemia, hyperphosphatemia, and metabolic acidosis are identified in this patient as complications of the uremic syndrome and thus should be addressed. There is evidence that hyperphosphatemia contributes to progressive renal injury and equivocal evidence that hypokalemia and metabolic acidosis may also contribute.

The cat was stabilized with fluid therapy, potassium supplementation, and antibiotics (oral cephalexin, 50 mg twice daily) and improved dramatically after 2 to 3 days. Antibiotic therapy was continued for 4 weeks, and a urine culture was submitted after 7 days of therapy. At this stage, systemic hypertension was recognized and proved to be persistent. This was stabilized with amlodipine treatment (0.625 mg once daily). The cat was gradually transferred to a renal clinical diet (restricted phosphate intake) and became stable with a plasma creatinine concentration of 2.75 mg/dl for about 9 months. At this point another uremic crisis coincided with recurrence of the UTI. The owners declined further therapy and opted for euthanasia.

Photo Credit: Photographs courtesy of Dr. H. Syme.

**See Aids & Resources, back page, for references, contacts, and appendices.**

**TAKE-HOME MESSAGES**

- **Increased creatinine and urea levels on a chemistry screen require careful consideration of the history and physical examination findings to classify the case appropriately.**
- **A full urinalysis is required in all azotemic patients and must include microscopic examination of urine sediment.**
- **Chronic renal failure is a heterogeneous syndrome. Measure urine protein-to-creatinine ratio (if urine sediment is inactive) and SABP to identify therapeutic targets.**
- **Reassess and monitor laboratory test results (including urine protein-to-creatinine ratio) and blood pressure. In animals that have recently deteriorated, reassess after stabilization, as blood pressure and plasma creatinine levels may change substantially after stabilization.**

GFR = glomerular filtration rate; SABP = systolic arterial blood pressure; UTI = urinary tract infection

# Additional Diagnostic Tests

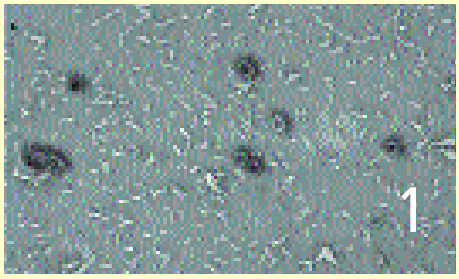
## Urine Sediment Examination

(+/– urine culture)

Rod-shaped bacteria may be visible on sediment examination (**Figure 1**); however, sediment examination is not accurate in ruling an infection in or out. Urine culture is the gold standard for diagnosing UTI. This is particularly true when the urine is dilute. The authors perform urine culture in cases of chronic renal failure where inflammatory cells are seen in the sediment and all cases that have just decompensated, but other experts recommend urine culture as the standard of care for all possible cases. It is difficult to say whether bacterial UTI causes decompensation, but it is a treatable problem and infected cats often improve clinically on antibacterial drug therapy.

## Assessment of Urine Protein Excretion

If examination shows inactive urine sediment and culture results are negative, the urine protein-to-creatinine ratio should be measured regardless of the results on dipstick analysis. In our experience, cats with a urine protein-to-creatinine ratio greater than 0.4 seem to have a worse prognosis than those with a ratio less than 0.4. The implication of this finding is that proteinuric animals (provided this is renal proteinuria) might benefit from antiproteinuric therapy (e.g., angiotensin-converting enzyme inhibitor treatment, dietary protein restriction, and/or n3 fatty acid supplementation). In this case, because the urine sediment was active and evidence of a bacterial UTI was present, we delayed assessing proteinuria until the infection was treated and resolved.




**Photomicrograph of an unstained urine sediment viewed under phase contrast conditions. Rod-shaped bacteria can be seen in focus. Inflammatory cells are out of focus (original magnification, ×400). This sample yielded a pure growth of *Escherichia coli* (>106 /ml of urine).**

## Measurement of 11rial Blood Pressure

All cats with a diagnosis of chronic renal failure are at risk for systemic arterial hypertension and should have their blood pressure measured. The Doppler technique is easiest and measures SABP only (**Figure 2**). Blood pressure is measured in conjunction with a retinal examination. An SABP below 150 mm Hg is considered normal in our clinic; an SABP between 150 and 180 mm Hg is considered borderline hypertensive and greater than 180 mm Hg is considered hypertensive.

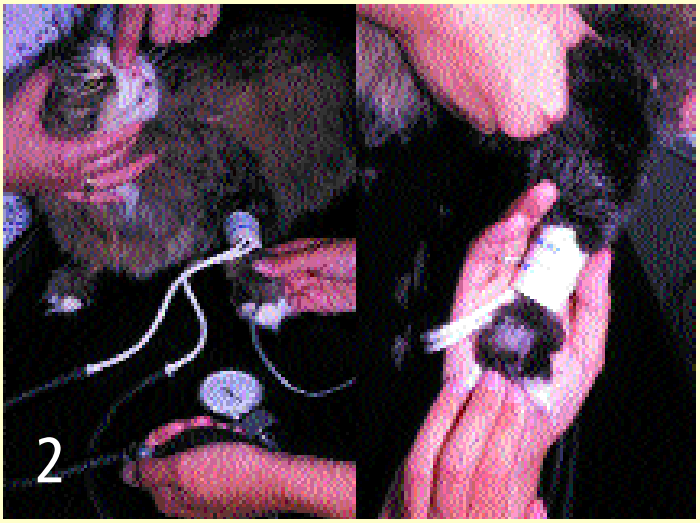
This particular cat has a heart murmur, which is common in normotensive cats with chronic renal failure (30% prevalence in our clinic) but is more common in hypertensive cats (70% prevalence). In addition, we have noted that hypokalemia is significantly associated with feline hypertension.

In this case, the initial SABP measurement was 146 mm Hg. However, after the cat was treated (fluid therapy, oral potassium citrate supplementation, and antibacterial drug therapy) and returned to a stable state at home, the pressure was measured as 192 mm Hg and hypertension was a persistent finding on repeated measurements over a 10-day period. Antihypertensive treatment was prescribed.

## Diagnostic Imaging of the Kidneys and Urinary Tract

(+/– renal biopsy)

The likelihood of finding abnormalities on such investigations increases in younger cats and in cats with palpably enlarged kidneys. For example, ureteral obstruction by calcium oxalate uroliths can occur—bilateral obstruction can lead to azotemia. Renal biopsy is usually the gold standard for identifying pathological renal processes; however, aged cats often have evidence of chronic interstitial fibrosis with glomerular sclerosis, in which case renal biopsy is not beneficial and may be difficult and even harmful.




**Measurement of systolic arterial blood pressure in a cat using the Doppler technique**

GFR = glomerular filtration rate; SABP = systolic arterial blood pressure; UTI = urinary tract infection