



Nephrology Case Studies

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Case Study – Dr. Aaronson

Case Study – Dr. Aaronson

A 77-year-old man is admitted to the cardiac ICU for **acute exacerbation of congestive heart failure (CHF)**.

Past medical history is significant for ischemic cardiomyopathy with an **ejection fraction of 35%**, **type 2 diabetes mellitus**, **hypertension**, chronic gastritis, and depression.

He has a 15-pack-year smoking history but quit 5 years ago. He drinks occasionally and has no history of recreational drug use.

Home medications include **insulin**, **amlodipine**, **bumetanide**, **lisinopril**, and **carvedilol**.

Case Study – Dr. Aaronson

On physical examination, **BP is 138/84 mm Hg**, heart rate is 84/min, and temperature is 37°C. **Jugular venous distension is noted 9 cm** above the sternal angle. Lungs have **coarse breath sounds** and **crackles** bilaterally. Cardiac examination reveals an S3 gallop. Extremities have **2+ pitting edema** and 1+ peripheral pulses.

Bumetanide IV is prescribed, urine output increases, and **symptoms of orthopnea improve** over the next few days.

Case Study – Dr. Aaronson

Laboratory data are as follows:

	Day 1	Day 4	Reference Range
WBC Count	6000/mL	8000/mL	4,000 - 8,000
Hemoglobin	10.9 g/dL	11.8 g/dL	14 -18
Platelets	189,000/mL	200,000/mL	150,000 - 450,000
Serum			
Sodium	142 mEq/L	140 mEq/L	136 - 145
Potassium	3.9 mEq/L	3.1 mEq/L	3.5 - 5.0
Chloride	108 mEq/L	88 mEq/L	98 - 106
Total CO2	28 mEq/L	38 mEq/L	23 - 28
BUN	20 mg/dL	8 mg/dL	8-20
Creatinine	1.4 mEq/L	0.6 mEq/L	0.7 - 1.3
Magnesium	1.8 mEq/L	1.5 mEq/L	1.6 - 2.6
B-Type natriuretic peptide, plasma	800 pg/mL	450 pg/mL	< 100
Arterial blood gas			
pH		7.5	7.38 - 7.44
pCO2		50	38 - 42
pO2		88	75 - 100

Case Study – Dr. Aaronson

Which ONE of the following is the next BEST step in managing this patient's metabolic alkalosis?

- Spironolactone
- Discontinue Bumetanide
- Ammonium Chloride
- Normal Saline
- Acetazolamide

Case Study – Dr. Aaronson

Answer: Spironolactone

The next best step in managing this patient with an acute exacerbation of CHF, hypokalemia, and metabolic alkalosis is to prescribe Spironolactone.

Case Study – Dr. Aaronson

Primary metabolic alkalosis secondary to aggressive use of diuretics commonly occurs in the treatment of CHF.

The mechanism involves inhibition of NaCl absorption proximal to the cortical collecting duct (CCD), leading to enhanced distal delivery of Na⁺ and water to the H⁺/K⁺-secreting segments of the distal nephron.

Natriuresis and the resulting volume contraction result in secondary hyperaldosteronism. High luminal Na⁺ concentrations and luminal flow rates in the cortical collecting duct (CCD), in the presence of high aldosterone levels, enhance H⁺ and K⁺ secretion. The net result is a metabolic alkalosis generated in the CCD and maintained by hypochloremia and volume contraction.

Case Study – Dr. Aaronson

Why spironolactone and not acetazolamide?

Spironolactone is an aldosterone antagonist, which causes a potassium-sparing diuresis and can improve the aldosterone-mediated metabolic alkalosis and hypokalemia while allowing ongoing diuresis.

There are also data that spironolactone and eplerenone improve patient outcomes in the treatment of systolic heart failure, although this is a long-term effect, and benefit would not be expected to be conferred in the acute setting.

Case Study – Dr. Aaronson

Concerns about spironolactone include hyperkalemia and hypotension, which are less likely in this patient with relatively high BP and hypokalemia.

Acetazolamide can help mitigate metabolic alkalosis by blocking bicarbonate reabsorption in the proximal tubule and would provide additional diuresis. However, acetazolamide would worsen hypokalemia by increasing sodium delivery to the distal nephron.

Case Study – Dr. Aaronson

Prescribing acetazolamide plus potassium supplementation may be a reasonable second-choice option but would require using two medications and titrating the dose of potassium.

Normal saline is the treatment of choice for patients with metabolic alkalosis and hypovolemia but would not be a suitable option in this patient with decompensated CHF who requires decongestion / diuresis.

Case Study – Dr. Aaronson

Ammonium chloride may be used for acid-loading in patients with refractory metabolic alkalosis by providing a source of H⁺ to titrate excess serum bicarbonate.

Although ammonium chloride may improve this patient's metabolic alkalosis, spironolactone would be a better option by addressing hypokalemia and providing additional decongestion / diuresis.

Discontinuing bumetanide is not a feasible option in this patient who continues to have evidence of volume overload and hypoxia and requires ongoing diuresis.

Case Study – Dr. Lund

Case Study – Dr. Lund

58 yo male presents locally with one week of lightheadedness, nausea and swelling of the lower extremities. He has a history of diabetes, hypertension and CKD 3a with baseline creatinine around 1.8 mg/dl. He was diagnosed with left leg cellulitis and treated with Bactrim one week ago.

Case Study – Dr. Lund

Medications: Amlodipine, Lisinopril, Metformin and Dapagliflozin.

Vitals: BP 110/68, pulse 98, respirations 18.

PE: appears fatigued, no distress, 96% saturation on room air, heart regular, lungs clear, 1+ LE edema, rest of exam unremarkable

Case Study – Dr. Lund

Lab: CBC normal, Na 130, K⁺ 6.2, HCO₃ 18, BUN 78, Creatinine 6.5

UA: SG 1.030, trace protein, no blood

EKG: sinus rhythm, no ST changes

Case Study – Dr. Lund

Patient is admitted for AKI, discussions begun regarding transfer to facility with Nephrology services for possible dialysis

Nephrology telemedicine can help with conservative management as well

Considerations: Acidosis, Electrolytes, Intoxications, Overload, Uremia

Case Study – Dr. Lund

Dialysis/referral considerations

Acidosis: $\text{pH} < 7.2$, options: HCO_3 bolus (50 mEq), D5 with 3 amps HCO_3

Electrolytes: Na/Ca/ Po_4 , K: Insulin/glucose, albuterol, IVF/Lasix, HCO_3 , Lokelma/Veltassa (kayexalate)

Intoxications: metformin lactic acidosis, Lithium, aspirin, ethylene glycol, methanol, etc

Case Study – Dr. Lund

Dialysis/referral considerations

Overload : pulmonary edema, hypoxia

Uremia: more chronic issue – fatigue – mental status changes unusual, nausea, itching, effusions

For most AKI - Dialysis does not help kidneys recover but does manage complications

Case Study – Dr. Lund

Outcome

Patient had no absolute indications for dialysis. Telemedicine evaluation with discussion of plan with patient/family

Case Study – Dr. Lund

Outcome

Initial K of 6.2

Lisinopril, Bactrim and dapagliflozin were held

UOP was 1200 ml/24 hour

Treated with insulin/glucose, IVF and Lasix

K trended down with treatment

Creatinine peaked at 6.9 mg/dl on day two then trended down

Manage expectations with family/staff

Case Study – Dr. Lund

AKI

Many variation of AKI and creatinine level is not a good predictor of ability to recover

UOP is a major determining factor

UA with degree of proteinuria/hematuria very helpful

Complications: AEIOU, many have conservative treatments and can be monitored by telemedicine

Questions?