August 2014 Critical Care Case of the Month: The Beans Are Done

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Case Presentation

A 68-year-old woman was admitted to the ICU due to acute renal failure in setting of ovarian cancer recurrence.

She reports a two week history of abdominal pain with increased, loose ileostomy output, nausea, one episode of vomiting of food returns, and profound increasing generalized weakness. She states she has been voiding urine in normal frequency. She took her most recent dose of Xarelto 20mg the evening prior to presentation.

On ICU arrival, she was alert and oriented but pale and underweight with dry mucous membranes. She reported 2/10 generalized abdominal pain. Her blood pressure was stable.

PMH

March 2013: Diagnosed with stage IIIC metastatic ovarian cancer. She underwent extensive abdominal surgery including radical hysterectomy, diverting loop ileostomy and cholecystectomy. Final pathology: grade 3 serous carcinoma involving omentum, descending colon, cecum and terminal ileum, both ovaries with implants on bilateral tubes and uterine serosa, right pelvic side wall, right diaphragm, 3 right paraaortic lymph nodes, and gallbladder.

April 2013: She developed thrombus of the bilateral peroneal veins, left posterior tibial vein, and right soleal veins and was started on Lovenox. She was recently transitioned to rivaroxaban (Xarelto).

February 2014: abdominal ultrasound showed numerous small, hypoechoic nodules and lesions throughout the liver which were worrisome for metastatic disease. She presented to the clinic today for a second opinion.

Current Medications

- Fentanyl 100 mcg/hr patch 72 hour 1 patch transdermally every 3 days

- Ibuprofen PRN
- Oxycodone PRN
- Rivaroxaban (Xarelto®) 20 mg daily
- Sertraline (Zoloft®) 25 mg daily

Past Medical/Surgical History

Past Medical History

1. Craniocervical dystonia receives Botox injections.
2. Ovarian cancer.

Past Surgical History

1. Appendectomy at 8 years old.
2. Tonsillectomy.
3. Laparoscopy in 1983 for infected Dalkon Shield.
4. L5 bulging disk surgery in the 1990s.
5. Total abdominal hysterectomy, bilateral salpingo-oophorectomies, cholecystectomy, lymphadenectomy, and tumor debulking for ovarian cancer March 2013.

Physical Exam

Vital signs: height 164.3 cm, weight 42.90 kg, BSA(G) 1.40 M², BMI 15.892 Kg/M², temperature 36.4 °C, respiratory rate 13 breaths/minute, blood pressure 148/77 mmHg. pulse 64/minute. SpO2 98% on room air.

Heart: S1, S2 with no murmur, click, rub. Sinus rhythm, rate 64, no ectopy.

Lungs: Respirations symmetrical and easy with bilateral breath sounds clear to auscultation.

Abdomen: Slightly firm, nondistended, mild tenderness to palpation, bowel sounds present. Ostomy pink with dark brown liquid output in bag^

Electrocardiogram

Figure 1. ICU admission electrocardiogram.

Ultrasonography

Figure 2. Panel A: Abdominal ultrasound of inferior vena cava. Panel B: Abdominal ultrasound showing longitudinal axis of left kidney. Panel C: Abdominal ultrasound showing longitudinal axis of right kidney.

Which of the following is (are) **true**?

1. The electrocardiogram shows tall, peaked T waves
2. The inferior vena cava is collapsed suggesting volume depletion
3. There is hydronephrosis of the left kidney
4. There is hydronephrosis of the right kidney
5. All of the above

Correct!
5. All of the above

The T waves appear tall and peaked in leads V4 and V5 (Figure 3) although there is no standard definition for tall, peaked T waves.

Figure 3. Electrocardiogram showing possible tall, peaked T waves (red arrows).

In this clinical setting considering hyperkalemia which causes tall, peaked T waves is reasonable. The patient's creatinine was 9.9 mg/dL and the potassium was 6.3 meq/L.

The IVC is nearly completely collapsed suggesting intravascular volume depletion (Figure 4A). There is bilateral hydronephrosis (Figures 4B and 4C).

Figure 4. Panel A: nearly collapsed inferior vena cava (IVC, yellow arrow). Panel B: left hydronephrosis (yellow arrow). Panel C: right hydronephrosis (yellow arrow).

Which of the following is (are) **false** regarding hyperkalemia?

1. Acidosis can increase the serum potassium.
2. Albuterol can decrease the serum potassium
3. Intravenous calcium is the agent of choice for life-threatening arrhythmias secondary to hyperkalemia
4. Succinylcholine is the induction agent of choice in hyperkalemia patients
5. All of the above

Correct!

4. Succinylcholine is the induction agent of choice in hyperkalemia patients

Succinylcholine is a depolarizing neuromuscular blocking agent that results in an efflux of potassium ions from the muscle cells into the serum. The resultant increase in hyperkalemia can precipitate severe cardiac events, including cardiac arrest. Acidosis can result in an increase in serum potassium, albuterol can acutely reduce serum potassium and intravenous calcium chloride is usually considered the drug of choice for arrhythmias secondary to hyperkalemia.

Urology was consulted and requested an abdominal CT which confirmed the marked bilateral hydronephrosis and demonstrated new liver and probable left lung metastases. They recommended bilateral ureteral stent placement as a palliative procedure.

However, the patient's prothrombin time (PT) and partial thromboplastin time (PTT) were modestly elevated.

Which of the following is (are) true?

1. Dialysis should be performed to remove the rivaroxaban
2. Rivaroxaban should be held for 2-4 days before performing the procedure
3. The elevated PT and PTT are likely due to liver metastases
4. The increased PT and PTT are likely secondary to renal failure
5. All of the above

Correct!

2. Rivaroxaban should be held for 2-4 days before performing the procedure

The elevated PT and PTT are consistent with the rivaroxaban she was receiving. Renal failure does not usually markedly affect and the PT and PTT although it does increase bleeding secondary to platelet dysfunction. Elevated PT and PTT can result from liver metastases but this is usually associated with a large number of metastases. Rivaroxaban is not dialyzable.

Her rivaroxaban was held for 2 days and she was taken to the operating room (OR) for bilateral stent placement. In the OR she was intubated using rocuronium, ketamine, fentanyl, and propofol. She had an unremarkable post-operative course.

CLINICAL PEARLS: (Useful information for care providers)

Prescriber Pearls (physicians/PAs/NPs) (Theodore Loftsgard R.N., C.N.P.)

1. Acute Renal Failure
 - a. UA, urine Sodium, urine creatinine.
 - b. D5W with 150 mEq of sodium bicarbonate 200 mls/hr for 5 hours.
 - c. CCS bedside on admission assessment and STAT Renal US
 - d. Avoid nephrotoxic medications
 - e. Consider Nephrology consult
 - f. Consider Urology consult depending on results of imaging
 - g. Urinary catheter placement with hourly monitoring.
2. Acute management hyperkalemia
 - a. Determine underline cause: Obstruction, dehydration, acute renal failure, diet, tumor lysis syndrome, Medications
 - b. Calcium Chloride IV, Albuterol nebulizers, Insulin IV followed by D50 IV, Kayexalate, sodium bicarbonate infusion, and Normal saline bolus.
 - c. EKG, Serum and urine electrolytes, frequent glucose monitoring following insulin IV and D50
 - d. Succinylcholine avoided in hyperkalemia patients. Rocuronium used for intubation and expected longer postoperative recovery. Peripheral Nerve stimulator assessment prior to weaning sedation.
3. Assessment of volume status in ICU
 - a. Data gathering: prior intake and output trends: Diarrhea, vomiting, malnutrition, changes in urine output, sweat production, prior edema. Weakness onset, polyuria, polydipsia
 - b. Exam:
 - i. Skin and mucous membranes: moist or dry. Skin tenting?
 - ii. Vitals: Postural hypotension? Dizziness?
 - iii. Laboratory: Urine output currently? Elevation in Creatinine and BUN. Urine osmolality, FENa, abnormal electrolytes.
 - c. Advanced measurements/ responsiveness
 - i. CVP (if central access obtained): This can be used as a guide on volume status. CVP does not adequately predict whether or not an

- intravenous fluid challenge will increase stroke volume and cardiac index.
 - ii. CCS bedside ultrasound: Among spontaneously breathing patients, the IVC diameter is a robust estimate of central venous pressure
 - iii. Passive Leg Raise: PLR induces larger increase in cardiac preload than and may be preferred for predicting fluid responsiveness.
- 4. Status Post Bilateral ureteral stent placement: Post stent placement diuresis with 400-800 mls/hr.
 - a. Fluid replacement to prevent further dehydration in an already dehydrated patient.
 - b. Monitor closely for stent obstruction and bleeding.
- 5. Newer anticoagulants and management in the peri-procedure period
 - a. High risk for bleeding with procedures.
 - b. No specific antidote for newer oral anticoagulants
 - c. If possible, defer urgent procedure for at least 12 hours.
 - d. Renal failure will prolong length of action.

Nursing Pearls (Jocelyn Coy R.N.)

1. Acute Renal Failure
 - a. Monitor intake closely. Strict I&Os. Hourly urine output.
 - b. Anticipate urine collection
 - c. Caution with diet, suggest renal failure diet. Education for patient
 - d. Education on Foley catheter
2. Acute Management of Hyperkalemia
 - a. Monitor for cardiac arrhythmias changes in mental status
 - b. Avoid diet with potassium.
 - c. Anticipate frequent labs
 - d. Assessment for hypoglycemia prior to insulin IV
 - e. Be aware of potassium sparing diuretics and alert providers
3. Volume Status in the ICU
 - a. Strict I&Os
 - b. Monitor hemodynamics as fluid status changes.
 - c. Caution with position changes
 - d. Assessment of CVP transducer at appropriate level
 - e. Assist with Passive Leg raising
4. Stent placement and postop management
 - a. Increased risk of bleeding: Avoid punctures if able due to Xarelto.
 - b. Monitor labs/electrolytes/creatinine. Monitor mental status as patient awakes from anesthesia/extubation. Peripheral nerve stimulator assessment prior to sedation weaning.
 - c. Acute pain: Assess for abdominal discomfort, provide pain relief as needed.
 - d. Coping Support: provide support to patient and family with prognosis.

Respiratory Therapy Pearls (Zanele Manaka R.R.T., C.R.T.)

Pre -Stent Placement-Recommended Respiratory care plan:

Problem #1. Hyperkalemia

PLAN: Beta-2 adrenergic agonists can drive potassium into the cells by increasing the activity of the Na-K-ATPase pump in skeletal muscle. Beta-2 adrenergic agonists can be effective in acute treatment of hyperkalemia, lowering serum potassium concentration by 0.5-1.5meq/L. Administer albuterol (2.5mg/3mL) nebulizers q15min x4 to decrease potassium. Monitor heart rate, as albuterol can cause tachycardia in higher doses.

Problem #2. Problem: Bibasilar Atelectasis

Plan: EzPAP therapy for lung expansion. EzPAP utilizes a fluidic process to augment spontaneous breathing to provide higher inspiratory flow and larger tidal volumes than on unsupported ventilation. The patient also exhales against resistance, creating PEEP (Positive End Expiratory Pressure) to stent the airways open and promote lung recruitment. The flow to the device should be initiated at a lower flow and increased slowly as the patient tolerates. Patient should be assessed pre and post therapy and monitored for any signs of distress as therapy will temporarily increase patient's work of breathing. Patient should be allowed to take rest periods during the treatment.

Post Stent Placement Assessment:

Patient intubated, sedated and paralyzed; ETT size 7.0 @ 22 at the teeth. Bilateral breath sounds. Placed on FiO2 .50; AC 20RR; 330 mL; PEEP 5cm H2O. PIP while intubated on AC settings 17-18 cmH2O; MAP 9.1-9.7cm H2O. ABGs on settings above: PaO2 217; PaCO2 46, pH 7.13 and HCO3- 15.

Plan:

Maintain ETT and mechanical ventilator. Ventilator adjustments can be made to temporarily correct metabolic acidosis by increasing the patient's respiratory rate (Adjustment formula used: Known Rate x Known CO2/Desired CO2). However, other corrective measures should be taken as hyperventilation will not solve the problem that drove the patient's metabolic acidosis.

When paralytic and sedatives turned off, ventilator settings should be weaned as patient tolerates assessing patient's ability to maintain appropriate oxygenation and ventilation in a spontaneous breathing mode.

Once the patient is extubated, supplemental oxygen should be provided to maintain SpO2 above 90%. Aggressive bronchial hygiene should be initiated. EzPAP or Incentive Spirometer would promote lung expansion, and Acapella should be used frequently to facilitate secretion clearance. Monitor patient's ability to cough and secretions closely as the patient is in a weakened state.

Pharmacy Pearls (Jared J. Jones, Pharm.D., R.Ph.)

1. Hyperkalemia Management: CaCl IV, albuterol nebs, regular insulin IV followed by D50w amp, and Kayexalate. Monitor electrolytes/serum creatinine/labs closely.
2. Metabolic acidosis: treated with bicarbonate drip, dehydration saline boluses for re-hydration.
3. Coagulation problems: Dc ibuprofen.
 - a. Xarelto (manufacturer recommends discontinuing in setting of acute renal failure).
 - i. Half-life is 11-13 hours in normal healthy patients, but 11-19 hours in the elderly.
 - ii. Renal dysfunction can lengthen the terminal half-life an indeterminate amount.
 - iii. Reversal is tricky because it is not dialyzable (92-95% plasma albumin binding).
 - iv. Beriplex, a 4 factor prothrombin complex concentrate, did reverse Xarelto's anticoagulant effects in healthy volunteers.
4. When stopping anticoagulation prior to a procedure, the ROCKET AF study suggested 2 days. With severe renal dysfunction, others have suggested doubling to 4 days for high bleed-risk procedures.
5. Stent placement and postop: Use rocuronium over succinylcholine in patients with hyperkalemia. Rapid onset of neuromuscular blockade, with shorter duration of action. However, the duration of neuromuscular blockade is variable in patients with renal failure. If necessary, can use neostigmine for reversal. Watch fluid status, replace as needed.
6. When anticoagulation is restarted, consider using unfractionated heparin (ACCP guidelines recommend against LMWH in severe renal failure) and consider switching to warfarin as anticoagulant of choice if renal dysfunction continues.

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