Case of the month

*Emergency Department's (ED) Case of the Month is a series of articles discussing topics important to family physicians working in the ED. This department covers selected points to help you avoid pitfalls and improve patient care in the ED. Submissions and feedback can be sent to **diagnosis@sta.ca**.*

Two Problems for the Price of One

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A 39 year-old male, Type 1 diabetic, presented to the emergency department with a complaint of weakness. He had been feeling sick for six days, but felt worse on the day of admission. He also complained of nausea, vomiting, decreased appetite, dry cough, sore throat, diaphoresis, and lower back pain. He was trying to control his blood sugars by varying the amount of insulin he used relative to his oral intake. He admitted that he had not been checking his sugars regularly, but they varied between 12 mmol/L and 20 mmol/L.

There were no past hospitalisations related to diabetes. The patient was otherwise well. On examination, the patient appeared ill.

There was an intermittent non-productive cough. Mucous membranes were dry. Head and neck exams were normal. Chest exam demonstrated tachypnea with crackles on the lower left chest. The cardiovascular exam, other than vital signs, did not reveal any abnormalities. The remainder of the exam was normal (Figures 1 and 2).

Patient Stats

Temperature	39.6 C
Heart Rate	116 beats/min
Blood Pressure	148/65 mmHg
Respiratory Rate	28 breaths/min

Lab Results:

WBC	19.4 X10^9
Hb	140g/L
Pl	175 X 10^9
Sodium	125 mmol/L
Potassium	4.7 mmol/L
Chloride	94 mmol/L
HCO_3	17 mmol/L
Gluc	19,1 mmol/L
ABG:pH	7.41
PCO_2	23 mmHg
PO_2	72 mmHg
HCO_3	14 mmHg
Base excess	-9

Figure 1.

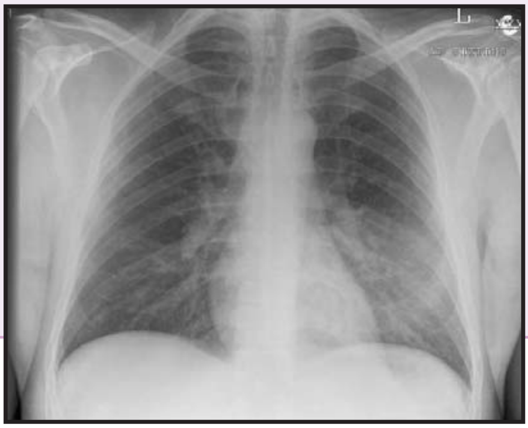

Figure 2.

Questions

1. **What clinical scenario are we dealing with?**
2. **What is the anion gap? Is this correct?**
3. **What is the arterial blood gas (ABG) interpretation?**
4. **Why is the bicarbonate (HCO_3) slightly different from that reported with the electrolytes?**

Answers

1. What clinical scenario are we dealing with?

This patient is a diabetic (therefore immunocompromised) with a left lobar pneumonia involving the superior and posterior segments of the left lower lobe (Figures 1 and 2). He is dehydrated and hyperglycemic due to the infection, recent poor diet, and lack of insulin control. He is hyponatremic partially due to his diuresis from hyperglycemia, there is possible mild syndrome of inappropriate secretion of antidiuretic hormone, and factitious hyponatremia due to the osmotic effect of hyperglycemia.

How to Calculate the AG

The anion gap (AG) represents the sum of unmeasured anions in the plasma or serum, measured as the difference between the sum of the measured cations (ignoring potassium, as its value changes so little), and anions.

The AG is calculated as follows: (Na – Cl – HCO_3 = < 12 normally.)

Elevated values may occur in cases where acidosis results from added cations while normal or low values occur in bicarbonate-losing metabolic acidosis (*i.e.,* lost anions).

2. What is the anion gap (AG)? Is this correct?

In the above case, the AG is: 125 – 94 – 17 = 14. Hyponatremia may result in the underestimation of the anion gap, as is undoubtedly the case in this patient.

3. What is the arterial blood gas interpretation?

Understanding these questions helps you appreciate that this patient is really quite sick. The arterial blood gas (ABG) on room air demonstrates a normal pH. However, there is a mixed metabolic acidosis and respiratory alkalosis. The metabolic acidosis is demonstrated by the low HCO_3 (it is 14 and the normal level is 24). The respiratory alkalosis is demonstrated by the low PCO_2 (it is 23 and the normal level is 40).

In this case, a strong stimulus for increased ventilation and the resulting low PCO_2 is hypoxia (PO_2 is 72 mmHg). He *should* have a pH of approximately 7.54 (0.08 X 17 "the difference in PCO_2"). However, the metabolic acidosis has depressed the pH by 0.15 (HCO_3 dropped to 14). The acidosis is due to dehydration, lactic acid, and early diabetic ketoacidosis. The acidosis gives a pH that is "normal" but only because several competing influences (all bad) are contributing. The patient's tachypnea is due to hypoxia from lung dysfunction (pus in the alveoli), as well as the metabolic acidosis stimulus—he is producing a respiratory alkalosis that exactly compensates for the metabolic acidosis. This puts the patient in a precarious position—despite the increased respiratory rate he is *just* compensating. If the dehydration, diabetes, or pneumonia worsens, he may develop acute respiratory failure with worsening acidosis and require intubation and mechanical ventilation. In the meantime, he requires supplemental oxygen, to maintain his PO_2 greater than 92%, and very close observation.

Practice Pointer

There are two "simple" rules to remember in acute ABG changes: for every change in the PCO_2 of 10 mmHg, the pH changes by 0.08 and for every change of 10 meq of HCO_3, the pH will change by 0.15.

4. Why is the bicarbonate (HCO_3) slightly different from that reported with the electrolytes?

The slight difference in HCO_3 between electrolytes and ABG may be due to lab error, but is also explained by the fact that the electrolyte HCO_3 is actually measured, whereas the ABG HCO_3 is calculated from the measured PCO_2 and pH. Thus, looking at electrolytes is a reasonable way to screen for metabolic acidosis without requesting the more painful ABG. ABGs are still useful for assessing PCO_2 and pH.

Further Discussion

He has community-acquired pneumonia and is an immune compromised host. The initial choices of antibiotics include a "respiratory" fluoroquinolone (NOT ciprofloxacin) or the combination of a macrolide and second-generation cephalosporin. Blood culture results may allow for a narrowing of therapy, however, mixed infections are common and the clinical utility of blood cultures in this setting has been questioned. His metabolic acidosis should be treated according to the mnemonic "FIPS"—**F**luid, **I**nsulin, **P**otassium (in anticipation of a drop in potassium as a result of insulin therapy), and **S**upportive therapy.

The pneumonia score is 104, giving a potential mortality of 4% to 10%.[1] The patient was admitted to an intermediate care bed under close observation. Dx

Reference

1. Fine MJ, Auble TE, Yealy DM, et al: A prediction rule to identify low-risk patients with community acquired pneumonia. N Engl J Med 1997; 336(4):243-50.