Investigation of the Week 22 November 2017

Note: Case is relatively simple to be used as a basis for a discussion about a different approach to acid-base interpretation.

Case:

- 2 year old girl presents to ED
- Known Type I diabetes
- Features of diabetic ketoacidosis – polyuria, polydipsia

The initial venous blood gas is below:

pH 7.011

pCO2 26 mmHg

BE -21.9

Lactate 2.8

Na 136 mmol/L

Cl 99 mmol/L

Question 1. How would you interpret this venous blood gas?

Question 2. What are your management priorities?

Repeat VBG 6 hours later:

pH 7.017

pCO2 27 mmHg

BE -21.5

Lactate 1.5

Na 138

Cl 121

Question 3. How would you interpret this VBG?

Question 4. What is the cause of the acid base abnormality? Is this child improving?

Quantitative approach to acid base problems

- First ask – how much of BE can be explained?
- Any BE that can't be explained – due to unknown ions
- How much are these factors contributing to BE?
    - Na-Cl difference
    - Albumin
    - Lactate

- Initial VBG
    - Na-Cl difference
    - Initial measured Na-Cl difference = 99-135 = 37
    - Normal difference = 38
    - So Cl increased slightly relative to Na -> expected BE -1
    - Lactate (negative charge)
        - Normal lactate 1.3
        - Measured lactate 1.5
        - Difference = 2.8 – 1.3 = 1.5
        - So increase anions – body makes more H – lactate causing acidosis
        - Expected BE from increased lactate = -1.5
    - Albumin (negative charge)
        - Normal 42
        - Measured 40
        - Difference = measured albumin – normal albumin = 40-42 = 2
        - Expected BE 2/4 -= + 0.5

    - Expected BE = (Na-Cl difference) + lactate effect + albumin effect = (-1) + (-1.5) + 0.5 = -2
    - Patient's BE is -21.9
    - Unknown ions causing 19.9 of BE – ketones, uraemia, toxins
    - To obtain cause – could measure ketones and urea and see if adds up to 19.9
- Repeat VBG
    - Na-Cl difference = 138-121 = 17
        - Normal Na-Cl difference = 38
        - Difference = 21
        - Cl increase relative to Na – expect BE -21
    - Lactate
        - Difference 1.5 -1.3 = 0.2 - -0.2 BE
    - Albumin
        - (35.6 – 42)/4 = + 1.6
    - Calculate expected BE = (-21) + (-0.2) + (+1.6) = -19.6
    - Unexplained ions = -21.5 – 19.6 = 1.9 of unexplained anions (normal +/-2)
    - So no significant unexplained ions

Na-Cl difference is making up most of BE

No significant unexplained ions -> so ketosis has resolved

Now have hyperchloraemic acidosis

- need to know this so don't give extra insulin or more fluid boluses of normal saline

- explained by looking at treatment – bolus then maintenance & deficit fluid with normal saline

Normal saline = 154 mmol Na per L, 154 mmol Cl per L – i.e. equal amounts

So normal saline increases Cl relative to Na -> body makes more H -> causes acidosis

Now can recognise change in acidosis and reason for change – so don't give more normal saline and make acidosis worse

Management from here:

- Hyperchloraemic acidosis will resolve with time if given less normal saline
- Change fluids to Hartmann's (Na 131 mmol/L, Cl 111 mmol/L – difference of 20; lactate added to balance electroneutrality – lactate metabolised quickly by liver, & replaced by bicarb)
- [Avoid Hartmann's with sig lactic acidosis – liver may not clear lactate (could use $NaHCO_3$ – giving Na without Cl, so it's the Na that causes alkalosis)]