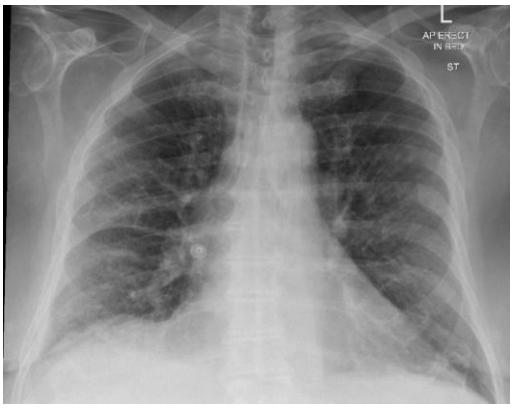
Clinical update no. 539

19 June 2019

Case: 78yr-M with background CCF and COPD presents with worsening peripheral oedema and shortness of breath.



The VBG suggested an underlying respiratory acidosis with compensation.

The ABG suggested an underlying metabolic alkalosis.

Note the pCO2 differs by 18 – not the routine "6" touted on twitter. ABGs remain useful.

	VENOUS	ARTERIAL
pH	7.39	7.45H
pCO2	65H	47H
HCO3	31.8	30.1
Base Excess	14.3H	8.7H

K 4.2, creatinine 125.

It makes a difference to know. The metabolic alkalosis relates to underlying diuretic use, not metabolic compensation for a respiratory acidosis with hypercapnoea.

Acid-Base Physiology

7.2 Metabolic Alkalosis - Causes

https://www.anaesthesiamcq.com/AcidBaseBook/ab7_2.php

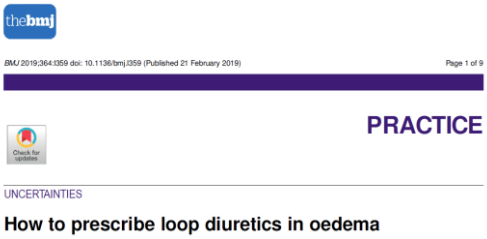
The kidney rapidly excretes bicarbonate if the plasma level is elevated > 24mmols/l, so a metabolic alkalosis will be rapidly corrected. Persistence of a metabolic alkalosis requires an additional process, such as loss of H^+ from the kidney (e.g. diuretic) or GI (vomiting).

Metabolic alkalosis is classified broadly as chloride depletion (with HCO3 reabsorption) and potassium depletion. 90% of cases are from gastric HCl loss and diuretics. Chloride deficiency results in the kidney reabsorbing HCO3 to maintain neutrality.

Diuretics cause renal tubular loss of Cl, and alkalosis is exacerbated by volume depletion (increases aldosterone), low salt diet and hypokalaemia. Potassium depletion leads to increased HCO3 reabsorption and H loss.

Broadly, metabolic alkalosis is chloride responsive (responds to 0.9% saline, with KCl as required; with urine Cl <10 mmol/L) or non-responsive (usually an endocrine cause with mineralocorticoid excess, with urine Cl >20). Acetazolamide (in itself a cause of non-gap metabolic acidosis) can help correct by increasing urinary HCO3 excretion.

So, a metabolic alkalosis, clarified by an ABG, and likely due to diuretic use and probably volume depletion. A useful review questions how loop diuretics are dosed and used, and suggests how to optimise prescribing.



The review focusses on managing oedema in patients with heart failure.

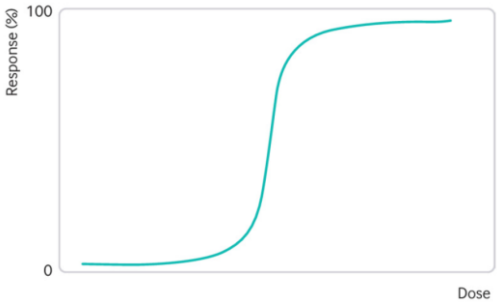
What you need to know

LOOP DIURETICS GIVE AN ALL-OR-NONE RESPONSE – EITHER "ON" OR "OFF".

There is no way to gradually increase or decrease the diuretic effect. A dose is either effective or it's not.

Titrating frusemide doses has no role. If a reduction in effect is required, then the effective dose needs to be given on fewer days. Reducing the daily dose will either have no effect if the dose is still effective, or else the reduced dose will be ineffective.

For an individual patient, a single dose is either subtherapeutic or therapeutic.



Dose-response curve (logarithmic) for loop diuretics.

The threshold dose may rise over time with progressive impairment in renal function.

Common myths about loop diuretics

Myth Do not use loop diuretics in patients with a sulfa allergy

Although they contain a sulfa moiety they are safe to give if a sulfa antibiotc allergy.

Myth Intravenous drip is more effective than bolus dosing for severe oedema

There is no advantage in giving by IV infusion.

Myth Stop diuresis if creatinine is rising

A rise suggests effective diuresis with nil adverse and possibly a mortality benefit.

Determine if the dose is working

Just ask if they pass more urine in the 4-6hr period after dosing. A higher dose above the threshold will not lead to greater diuresis. If the dose is below the threshold urine output will not change.

Common errors in loop diuretic use

- Multiple different daily doses, or variable doses, e.g. frusemide 40mg mane 20 mg midde, or take 20mg but increase to 40mg "as needed". If 40mg is the effective dose, then 20mg isn't. Use the dose that works.
- Increasing dose from what is effective. If 40mg works, 80mg won't be any better.
- Giving an ineffective dose more often, e.g. 40mg mane doesn't work, so take it twice daily (it still won't work).

What to do when more or less diuresis is needed

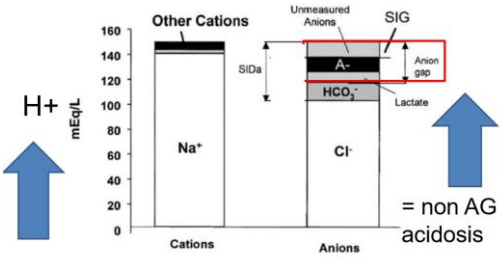
Thiazides are less potent than loop diuretics and are an option for mild oedema. Potassium sparing diuretics on their own are about 3% as effective as loop diuretics. Rather than decrease the effective daily dose of frusemide it is better to use it less days.

Adding another agent may be needed if further diuresis is required. Alternatively a repeat dose of frusemide at least 6 hours after the first may be effective.

Drugs that reduce the effect of loop diuretics

ACE- inhibitors, ARBs and NSAIDs reduce GFR and as a result reduce the diuretic effect.

Case resolution: There is persisting oedema despite frusemide use, and a metabolic alkalosis. Higher doses may be effective but an option is to add a potassium sparing diuretic. Note that potassium sparing diuretics, as well as other drugs for CCF such as ACE-inhibitors contribute to a non-gap acidosis and may address that aspect.



A non gap acidosis is related to an increase in strong anions being balanced by a rise in H . HCO3 is not a strong anion (it dissociates).

A reduction in strong anions, notably Cl and H (also albumin) contributes to an alkalosis.

Causes of Non–Anion Gap Acidosis

III. Drug-induced hyperkalemia (with renal insufficiency)

e.g. pottasium sparing diuretics, ACE inhibitors and ARBs, NSAID