2009.2.3 (ABG)

A 59 year old obese man receives 5 mg of intravenous morphine for analgesia for abdominal pain. Thirty minutes later, his GCS has fallen to 12 and investigations are performed.

			Reference Range
FiO_2	0.21		
pH	7.24		7.35-7.45
pCO_2	92	mmHg	35-45
pO_2	45	mmHg	80-95
Bicarbonate	49	mmol/L	22-28
Base excess	10		-3 - +3
O_2 saturation	78	%	> 95
Lactate	1.2	mmol/L	< 1.3
Na^+	142	mmol/L	134-146
K^+	3.8	mmol/L	3.4-5
Cl^-	86	mmol/L	98-106
Glucose	11.4	mmol/L	3.5-5.5
Haemoglobin	184	g/L	135–180
Carboxy Hb	7	%	< 6%

Describe and interpret his investigations. (100%)

Note not stated if arterial or venous blood gas
This blood gas has multiple abnormalities but the most striking are underlying metabolic alkalosis with superimposed acute respiratory acidosis, critical hypoxaemia (if arterial sample), hyperglycaemia, and polycythaemia.

Summary

acidaemia
marked hypercarbia
hypoventilation
    likely due to CNS depression after morphine administration
    no clinical suggestion of neuromuscular / chest wall pathology
critical hypoxaemia
    due to hypercarbic respiratory failure in presence of normal A-a gradient
markedly raised bicarbonate with raised base excess
    metabolic alkalosis
        glucocorticoid excess (steroids / Cushing syndrome) possible but low potassium expected
        vomiting (expect low potassium)
        bicarbonate administration (possible antacids for abdominal pain)
        compensatory for chronic respiratory acidosis
markedly reduced oxygen saturations
moderate hypochloraemia
    likely passive shift to maintain electroneutrality

moderate hyperglycaemia
- glucocorticoid excess (Cushing syndrome, steroids both possible particularly in obese patient)
- absolute or relative insulin deficiency
- IDDM
- NIDDM (in keeping with obesity)

mild polycythaemia
- chronic hypoxia suggesting degree of chronic respiratory acidosis
- haemoconcentration if reduced oral intake, vomiting (abdominal pain)

mild elevation in carboxyhaemoglobin
- cigarette smoking or exposure

Acid base
A – acidaemia
R – high pCO2, so respiratory acidosis suggested
M – high bicarbonate suggests metabolic alkalosis or compensation
A – anion gap 142-86-49 = 7 is normal
D – not relevant

assuming respiratory acidosis
expected bicarbonate
2 for 10 acutely = 5.2×2 = 10 rise in bicarb -> 34
5 for 10 chronically = 5.2×5 = 26 rise -> 50 expected, measured 49
clinical scenario is more in keeping with element of acute respiratory acidosis however due to
- polycythaemia (chronic hypoxia)
- obesity (predisposing factor)

if pre-existing metabolic alkalosis
expected pCO2 = 0.7×49+20 = 54
this would support clinical scenario as it allows for acute respiratory element
i.e. compensated chronic metabolic alkalosis with superimposed acute respiratory acidosis

A-a gradient
150-(92×1.25) = 35 expected, 45 measured
implies on FiO2 >0.21 as gradient is negative, but as A-a gradient formula is an estimation this may be possible with an arterial sample.

Need all in bold to pass
Acid base disorder
Mixed acid base disturbance with acute respiratory acidosis and underlying metabolic alkalosis
Or alternatively chronic respiratory acidosis considered acceptable if supporting corrective calculations performed to justify this view despite being discrepant with scenario
Supporting calculations
Critical hypoxemia
At least 5 from
hypochloraemia
hyperglycaemia
polycythaemia
raised carboxyhaemoglobin
hypercarbia
hypoxaemia
high bicarbonate
high base excess
with reasonable interpretation of at least 3 of these