**Case 1**

8 year old girl arrives with a history of wheeze and tachypnoea. She has been given nebulised salbutamol every 15 minutes at home for 4 hours and a burst of puffer salbutamol in the ED. She deteriorates and a VBG is taken.

Obs: RR 42, HR 152, Sats 89% in room air, Temp 37.3

|  |  |
| --- | --- |
| pH | 7.32 |
| pCO2 | 30 |
| Bicarb | 15 |
| Base Excess | -2 |
| Na+ | 138 |
| Cl- | 103 |
| K+ | 3.1 |
| Lactate | 6 |
| Glucose | 7.5 |

**Case 2**

15 year old girl is brought to ED by her friends with abdominal pain, weakness and diarrhoea. She has lost 10 kg in the last few months. She is tachypnoeic and lethargic. She is thought to be clinically dehydrated and a VBG is done.

HR 45, RR 27, BP in normal range but with a postural drop.

|  |  |
| --- | --- |
| pH | 7.29 |
| pCO2 | 26 |
| Bicarb | 12  |
| Base Excess | -6 |
| Na+ | 125 |
| Cl- | 103 |
| K+ | 2.8 |
| Lactate | 0.2 |
| Glucose | 5.2 |

**Case 1**

Formulation: **Metabolic Acidosis with a Respiratory Alkalosis**

Diagnosis: Salbutamol Toxicity causing lactic acidosis, hypoxaemia.

Learning Points:

1. Salbutamol toxicity
* Tachycardia, tachypnoea, metabolic acidosis, tremor
* Danger of precipitating arrhythmias
1. Mechanisms of High Lactate in Severe Asthma
* fatiguing respiratory muscles
* Stimulation of β adrenergic receptors leads to a variety of metabolic effects including increase in glycogenolysis, gluconeogenesis and lipolysis contributing to lactic acidosis.

Management: Less Salbutamol

Try other agents.

**Case 2**

Formulation: **Chronic Metabolic Acidosis with a Respiratory Compensation**

Diagnosis: Laxative abuse causing diarrhoea

Learning Points:

Anion Gap = Na – (Cl + HCO3)
Normal is 3-10mmol

|  |  |
| --- | --- |
| High Anion Gap (HAGMA) – There is an additional acid in the body* Renal Failure
* DKA
* Alcoholic Ketoacidosis
* Lactic acidosis
* Ethylene Glycol intoxication
 | Normal Anion Gap (NAGMA) – There is a problem with Na, Cl or Bicarb. * Chloride Excess, bicarbonate loss
* Acetazolomide
* Addisons
* GI Causes (diarrhoea, vomiting, fistulae…)
* Renal Tubular Acidosis
 |

**Case 3**

A 5 year old girl with significant developmental delay is brought in to ED agitated and distressed. She requires a hoist for mobility and uses a wheelchair. She is non-verbal.

|  |  |
| --- | --- |
| pH | 7.65 |
| pCO2 | 10 |
| Bicarb | 18 |
| Base Excess | 0.2 |
| Na+ | 137 |
| Cl- | 110 |
| K+ | 3.2 |
| Lactate | 0.5 |
| Glucose | 7 |

**Case 4**

A three month old boy is brought into the department with non-bilious profuse vomiting.

|  |  |
| --- | --- |
| pH | 7.62 |
| pCO2 | 54.4 |
| Bicarb | 56 |
| Base Excess | 3.1 |
| Na+ | 136 |
| Cl- | 72 |
| K+ | 3.0 |
| Lactate | 1.7 |
| Glucose | 8.7 |

**Case 3**

Formulation:

**Respiratory Alkalosis with Metabolic Compensation**

Diagnosis: Pain causing hyperventilation

Learning Points:

What are the causes of a respiratory alkalosis?

* Hyperventilation
	+ Pain
	+ Anxiety
	+ Voluntary
* Hypoxaemia/ PE /Asthma

Compensation:

Acute: Bicarb reduces by 2mmol/L for every 10mmHg drop in pCO2

Chronic: Bicarb reduces by 4mmol/L for every 10mmHg drop in pCO2

**Case 4**

Formulation:

**Metabolic Alkalosis with Respiratory Compensation**

Diagnosis: Pyloric Stenosis

Learning Points:

Loss of Hydrochloric Acid causes alkalosis. There is often minimal respiratory compensation.

Causes significant electrolyte derangements.

Management:

Resuscitation: 10-20ml/kg 0.9% NaCl

Replace fluid deficit and ongoing losses.

NG tube for free drainage

Surgical correction is delayed until correction of dehydration, electrolytes and acid base status.

**Case 5**

A 6 year old is brought to hospital with breathlessness. Her father isn’t worried and thinks that she is anxious about going to school. She has lost 1.5kg over the past two months.

|  |  |
| --- | --- |
| pH | 7.19 |
| pCO2 | 25 |
| Bicarb | 7.1 |
| Base Excess | 6 |
| Na+ | 140 |
| Cl- | 111 |
| K+ | 4.3 |
| Lactate | 0.2 |
| Glucose | 18.2 |

**Case 6**

A 34 week gestation neonate has come to the special care nursery on CPAP of 6cm with FiO2 25% for respiratory distress thought to be TTN. 6 hours after starting CPAP a VBG is taken to assess progress.

|  |  |
| --- | --- |
| pH | 7.50 |
| pCO2 | 28 |
| Bicarb | 20 |
| Base Excess | -0.1 |
| Na+ | 137 |
| Cl- | 103 |
| K+ | 4.3 |
| Lactate | 0.2 |
| Glucose | 3.1 |

**Case 5**

Formulation: **Metabolic Acidosis with respiratory compensation.**

Diagnosis: Diabetic Ketoacidosis

Learning Points: DKA can present in numerous ways. Every breathless child or child with a vague story needs a BSL.

Anion Gap = 14

**Case 6**

Formulation: **Respiratory alkalosis without compensation**

Diagnosis: Over ventilation

Often neonatal respiratory distress is transient and we need to know when to wean respiratory support.

Management: Reduce or cease CPAP

**Case 7**

A four month old baby is admitted with a cough, fever and widespread crackles and wheeze.

|  |  |
| --- | --- |
| pH | 7.31 |
| pCO2 | 61 |
| Bicarb | 27 |
| Base Excess | -0.1 |
| Na+ | 137 |
| Cl- | 111 |
| K+ | 4.3 |
| Lactate | 0.2 |
| Glucose | 4.2 |

**Case 8**

A 12 year old boy presents with fever, cough and right sided crepitation.

HR 100, RR 22, Sats 88% in RA.

|  |  |
| --- | --- |
| pH | 7.32 |
| pO2 | 48 |
| pCO2 | 55 |
| Bicarb | 33 |
| Base Excess | 3.2 |
| Na+ | 138 |
| Cl- | 104 |
| K+ | 4.4 |
| Lactate | 0.4 |
| Glucose | 4.1 |

**Case 7**

Formulation: **Respiratory Acidosis**

Diagnosis: Bronchiolitis with respiratory failure.

Learning Points: Note the high oxygen which is a signs that the child is receiving adequate/excessive supplemental oxygen but still developing respiratory failure.

**Case 8**

Formulation: **Respiratory Acidosis with Metabolic Compensation**

Diagnosis: Pneumonia with respiratory compromise and hypoxia.

Management:

Requires supplemental oxygen

IV antibiotics –Benzylpenicillin or broader

IVF

Admission

Most likely requires a chest X ray.

**Case 9**

A 12 year old girl is brought into pathology for routine blood tests before she starts studying medicine. You get a call from the lab because her VBG is abnormal.

|  |  |
| --- | --- |
| pH | 7.48 |
| pO2 | 105 |
| pCO2 | 24 |
| Bicarb | 18 |
| Base Excess | 0.9 |
| Glucose | 5.6 |

**Case 10**

 A five year old boy presents with a high fever of 39.8 associated with a petechial/purpuric rash that has progressed quickly. His cap refill time is 5sec.

|  |  |
| --- | --- |
| pH | 7.3 |
| pCO2 | 37 |
| Bicarb | 16 |
| Base Excess | -4.5 |
| Na+ | 138 |
| Cl- | 104 |
| K+ | 4.4 |
| Lactate | 5.7 |
| Glucose | 3.2 |

**Case 9**

Formulation: **Acute Respiratory Alkalosis**

Diagnosis: Hyperventilation

Learning Points: This is a mild respiratory alkalosis. This teenager is having a panic attack and hyperventilating. The oxygen level is high due to over-breathing.

A paper bag is commonly used to treat panic attacks because it allows re-breathing of the CO2 and so preventing the alkalosis.

Please note that a blood gas is not a routine investigation during panic attacks.

**Case 10**

Formulation: **Metabolic Acidosis – high lactate**

Diagnosis: Sepsis, likely meningococcal

Management: This boy will need intravenous fluids to correct his poor perfusion and intravenous antibiotics such as penicillin or a cephalosporin. Note the high oxygen level.

**Case 11**

A 3 year old is brought in by ambulance after being found in the neighbour’s pool

|  |  |
| --- | --- |
| pH | 7.05 |
| pO2 | 32 |
| pCO2 | 105 |
| Bicarb | 17 |
| Base Excess | -14.3 |
| Glucose | 5.0 |
| Lactate | 9.2 |

**Case 12**

A three year old boy is climbing a fence in the garden when it falls on him crushing his leg. He is removed and brought into the ED.

|  |  |
| --- | --- |
| pH | 7.29 |
| pCO2 | 28 |
| Bicarb | 12 |
| Base Excess | -6.9 |
| Na+ | 138 |
| Cl- | 104 |
| K+ | 5 |
| Lactate | 4.6 |
| Glucose | 4.5 |

**Case 11**

Formulation: **Mixed Metabolic and Respiratory Acidosis.**

Diagnosis: Near Drowning.

Respiratory acidosis due to hypoxia

Metabolic acidosis due to hypo-perfusion.

Learning Points: Drowning is the leading cause of unintentional injury death in children aged 1–3 years.

Swimming lessons do not prevent drowning.

**Case 12**

Formulation: **Metabolic Acidosis with Partial Respiratory Compensation**

Diagnosis: Crush injury causing lactic acidosis.

Management: Lactate can be a good indicator of anaerobic metabolism in cases of injury or suspected hidden necrotic tissue such as NEC, fasciitis or crush injury.

**Case 13**

A 7 month old boy with congenital heart disease is on frusemide to manage heart failure.

|  |  |
| --- | --- |
| pH | 7.48 |
| pO2 | 32 |
| pCO2 | 43 |
| Bicarb | 34 |
| Base Excess | 3.9 |
| Sodium | 115 |
| Potassium | 2.3 |
| Glucose | 4.5 |
| Lactate | 0.1 |

**Case 14**

A 3 week old boy is brought into ED very unwell. He is receiving respiratory support, he is hypovolaemic with poor perfusion and cap refill 5 sec. His abdomen is rigid. He has a lump in his groin.

|  |  |
| --- | --- |
| pH | 7.15 |
| pCO2 | 63 |
| Bicarb | 12 |
| Base Excess | -12.1 |
| Na+ | 137 |
| Cl- | 104 |
| K+ | 5.1 |
| Lactate | 4.7 |
| Glucose | 4.5 |

**Case 13**

Formulation: **Chronic Metabolic Alkalosis**

Diagnosis: Secondary to potassium deficiency caused by Frusemide.

Learning Points:

In potassium deficiency, hydrogen ions move intracellularly to replace potassium. The shift of hydrogen intracellularly causes a metabolic alkalosis.

This child needs potassium sparing diuretics included in his management.

**Case 14**

Formulation: **Mixed Metabolic and Respiratory Acidosis.**

Diagnosis: Incarcerated inguinal hernia causing bowel infarction and sepsis.

The obstructed contents of the bowel were splinting the diaphragm preventing respiration and thus causing a respiratory acidosis

Management:
ABCD approach

IVF boluses

Intubation and Ventilation

Prompt surgery

**Normal Values**

|  |  |
| --- | --- |
| pH | 7.45 🡪 7.45 |
| pCO2 | 35 🡪 45 |
| Bicarb | 22 🡪 28 |
| Base Excess | -3 🡪 3 |
| Na+ | 130 🡪 145 |
| Cl- | 101 🡪 110 |
| K+ | 3.5 🡪 6.5 |
| Lactate | < 2 |
| Glucose | 3.5 🡪 5.4 |

**Anion Gap:**  Na+ - (Cl- + HCO3-) < 12 mmol

**Normal Values**

|  |  |
| --- | --- |
| pH | 7.45 🡪 7.45 |
| pCO2 | 35 🡪 45 |
| Bicarb | 22 🡪 28 |
| Base Excess | -3 🡪 3 |
| Na+ | 130 🡪 145 |
| Cl- | 101 🡪 110 |
| K+ | 3.5 🡪 6.5 |
| Lactate | < 2 |
| Glucose | 3.5 🡪 5.4 |

**Anion Gap:**  Na+ - (Cl- + HCO3-) < 12 mmol