

## Investigation vignette

# A 24 Year old Woman Admitted to the Critical Care Unit, with 'Resistant' Asthma and a Metabolic Acidosis

### CASE REPORT

A 24 year old woman was admitted to the critical care unit with a 'resistant' asthma attack. She had a past history of mild asthma since childhood which was exacerbated by upper respiratory tract infections, exercise and red wine. She had been admitted to hospital for severe asthma attacks on four previous occasions although for the last two years she had been well controlled on budesonide 200 µg 12-hourly and had required only intermittent use of her salbutamol inhaler.

She was admitted on this occasion with a 12 hr history of progressive shortness of breath following the recent development of a sore throat, malaise and headache. Her salbutamol inhaler had given her some relief although this had not been sustained. At the accident and emergency (A & E) department her blood pressure was 120/70 mmHg, pulse 110 beats per minute, respiratory rate 28 per minute, temperature

36.8°C and on auscultation she had generalised wheezing. Her chest X-ray demonstrated no major abnormality apart from moderate hyperinflation. Her arterial blood gas analysis revealed a PO<sub>2</sub> of 72 mmHg, PCO<sub>2</sub> 31 mmHg and pH 7.43.

She was treated with continuous nebulised salbutamol and intravenous hydrocortisone 100 mg 6-hourly. However, throughout the next 8 hours she became more dyspnoeic and agitated and was admitted to the critical care unit for further management. Her vital signs at this stage revealed a pulse rate of 150 beats per minute, blood pressure 130/60 mmHg, respiratory rate of 40 per minute and on auscultation her lungs appeared to be clear.

The arterial blood gas and plasma biochemistry performed at this stage (Figure 1) led to the diagnosis.

Name	Age	Sex	Time of Collection Analysis		Date
Mrs. C. N.	24	F	1850	1900	30.7.00

Sodium	140	mmol/L	(137 - 145)
Potassium	3.0	mmol/L	(3.1 - 4.2)
Chloride	104	mmol/L	(101 - 109)
Bicarbonate	14	mmol/L	(22 - 32)
Anion Gap	25	mEq/L	(8 - 16)
Glucose	12.9	mmol/L	(3.0 - 6.0)

PO <sub>2</sub>	142	mmHg	(0.70 - 1.25)
PCO <sub>2</sub>	24	mmHg	(2.10 - 2.55)
pH	7.37		(7.35 - 7.45)
HCO <sub>3</sub> <sup>-</sup>	13	mol/L	(4 - 20)
BE	-11	mol/L	(4 - 20)

**Figure 1.** Plasma electrolytes, glucose and blood gases taken from an arterial specimen on admission to the critical care unit

**Diagnosis: Salbutamol induced lactic acidosis**

Continuous nebulised salbutamol is the treatment of choice for acute severe asthma requiring hospital admission.<sup>1,2</sup> However, it is recommended that salbutamol should be used until an adequate clinical response occurs or adverse effects (e.g. tachycardia, arrhythmias, tremor or lactic acidosis) limit further administration.<sup>3</sup>

The patient had an arterial blood lactate level on admission to the A & E department of 1.5 mmol/L with a base excess of - 3 mmol/L. However, when she was admitted to the critical care unit eight hours later, the arterial blood lactate level was 8.4 mmol/L with a base excess of - 11 mEq/L. The dyspnoea and agitation that were recorded were considered to be due to a worsening of the bronchospasm although clinically the patient had a clear chest.

Asymptomatic lactic acidosis has been reported previously during an acute asthmatic attack, and attributed to excessive respiratory muscle work, hypoxaemia and relative liver ischaemia.<sup>4</sup> Hyperlactataemia has also been linked to beta<sub>2</sub> adrenergic therapy in asthma,<sup>5</sup> although lactic acidosis causing increasing dyspnoea in the asthmatic patient has only been recorded infrequently.<sup>6-8</sup>

Lactic acidosis due to excessive beta<sub>2</sub> adreno-receptor stimulation is caused by an increase in glycogenolysis (by activating muscle and hepatic glycogen phosphorylase) which increases both pyruvate and lactate production. Also, an increase in plasma lactate in the absence of tissue hypoxia can be caused by an increase in acetyl CoA and NADH (due to catecholamine activation of hormone-sensitive lipoprotein lipase) which inhibit pyruvate oxidation.<sup>9</sup>

The metabolic effects of beta<sub>2</sub> adrenoreceptor stimulation caused by salbutamol (e.g. hypokalaemia, hypocalcaemia, hypomagnesaemia, hyperglycaemia) are well known,<sup>10,11</sup> and may be enhanced by theophylline<sup>12</sup> and glucocorticoids.<sup>13</sup> On admission to the critical care unit the plasma potassium was 3.0 mmol/L and glucose was 12.4 mmol/L, consistent with excessive beta<sub>2</sub> adrenoreceptor stimulation.

Dyspnoea associated with asthma may be due to a worsening of bronchospasm with hypercapnoea and obtundation requiring further bronchodilator therapy. However, lactic acidosis induced by beta<sub>2</sub> agonist therapy (with acidosis and hypocapnoea), if misinterpreted, can lead to an inappropriate increase in

bronchodilator therapy, highlighting the importance of continuous clinical assessment during the treatment of asthma so that beta<sub>2</sub> adrenergic agonists can be discontinued when they are not required.

**D. WILLMOT**

*Department of Critical Care Medicine, Flinders Medical Centre, Adelaide, SOUTH AUSTRALIA*

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