

# Overcoming the problem of pseudohypoxemia in myeloproliferative disorders: Another trick in the bag

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## Abstract

Pseudohypoxaemia or spurious hypoxaemia is a recurrent problem faced on arterial blood gas analysis in patients with hyperleucocytosis leading to management dilemmas and unnecessary respiratory interventions. Various methods have been suggested to reduce the magnitude of this problem. We report a case of pseudohypoxaemia due to blast crisis in a patient of chronic myeloid leukaemia where arterial blood gas analysed from precooled syringe helped us resolve the problem and hastened our weaning from oxygen therapy.

**Keywords:** Chronic myeloid leukaemia, precooling, pseudohypoxaemia

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## Introduction

Pseudohypoxaemia is commonly encountered when interpreting oxygenation in diseases with hyperleucocytosis and thrombocytosis. Various methods of overcoming this problem have been reported. We suggest precooling of the syringes before drawing the blood for analysis as another useful method of reducing oxygen consumption by the hyper metabolic cells.

## Case Report

41 year old male, diagnosed with chronic myeloid leukaemia (CML) for five years with multiple admissions for easy fatigability, abdominal pain, distension, fever and vomiting was treated conservatively with hydroxyurea and multiple blood transfusions. On this admission he was posted for splenectomy due to massive splenomegaly. Bilateral basal crepitations was noted on chest auscultation. Investigations showed haemoglobin-8.7 g.dL<sup>-1</sup>, total leucocyte (WBC) count-5, 09, 600 cells mm<sup>-3</sup>, platelet count-

1,14,000 cells mm<sup>-3</sup>, renal function, serum electrolytes and ECG were normal. Echocardiogram revealed minimal pericardial effusion. Chest X-ray showed cardiomegaly with normal lung fields. Patient underwent splenectomy uneventfully. Intraoperatively, he maintained oxygen saturation (SpO<sub>2</sub>) of 99-100%. Intraoperative arterial blood gas (ABG) analysis done on FiO<sub>2</sub> 0.5 showed a pH-7.303, PaCO<sub>2</sub>-47.9 mmHg, PaO<sub>2</sub>-47.8 mmHg, standard bicarbonate- 23.2 mmol. L<sup>-1</sup>. In view of poor oxygenation as per the report, he was shifted to intensive care unit (ICU) for ventilator support suspecting pulmonary atelectasis. ABGs done in ICU also showed poor oxygenation [Table 1].

Based on clinical improvement and pulse oximetry findings of 99-100%, he was weaned of ventilator support, extubated and discharged out of ICU.

Postoperatively, patient was diagnosed to be in blast crisis in view of increasing platelet and WBC counts. He was started on hydroxyurea and allopurinol tablets to achieve cytoreduction. He was intubated and readmitted to ICU following an episode of generalised tonic-clonic seizure, altered sensorium and desaturation on oxygen therapy of 60% venturi by face mask.

ABGs done after this admission also showed poor oxygenation with acceptable acid base status [Table 2].

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Chest radiograph did not show any deterioration. Meanwhile patient regained consciousness over a period of one day and tolerated pressure support ventilation and continued to maintain SpO<sub>2</sub> of 98-100%. In view of the continued picture of hypoxaemia on serial ABGs, normal SpO<sub>2</sub> and presence of blast crisis, a diagnosis of pseudohypoxaemia was made. Since point-of-care ABG analyser was not available, ABG repeated as rapidly as possible (delay of 7 minutes) from the sample immediately stored in ice showed a PaO<sub>2</sub> of 71 mm Hg on FiO<sub>2</sub> of 0.4 which was better than about 50 mm Hg consistently obtained in all the previous reports. We were prompted to precool the syringe even before obtaining the sample so that cooling the sampled blood could be hastened and the metabolism of cells be reduced more promptly.

We did three ABGs, one from sample obtained in a precooled syringe (kept in the freezer for 30 minutes and taken out just before drawing blood from a pre-existing arterial line), second from syringe immediately cooled in ice after sampling and another sample stored similarly but after a time delay of about 7 minutes after withdrawal. The time delay between sampling and analysis in first two samples was about 3 minutes. The ABGs are depicted in Table 3.

These values not only proved the diagnosis of pseudohypoxaemia but also indicated the usefulness of precooling of the syringe before sampling. We also noticed a minimal increase in PaCO<sub>2</sub> values in samples analysed from the syringes without precooling.

The patient was extubated, shifted out of ICU and recovered uneventfully in the ward and was discharged on hydroxyurea and allopurinol medications.

## Discussion

Fox *et al* first described the term 'leucocytic larceny' in 1979 as false low plasma oxygen tension measurement in leukaemia due to increased oxygen consumption by WBCs.<sup>[1]</sup> WBCs are about 45 times more metabolically active than platelets. However, since the platelet number far exceeds the WBCs, both cell types would contribute equally to the amount of oxygen consumption.<sup>[2]</sup> Blast cells being more metabolically active, consume more oxygen.<sup>[3]</sup> It is also reported that they would coat the sensing electrodes resulting in interference with analysis.<sup>[4]</sup>

Patients with leukaemia and myelodysplasia show false reduction in PaO<sub>2</sub> values associated with time delay in analysis of the sample. Metabolically active cells in the sample continue to consume oxygen resulting in such a reduction which is widely regarded as spurious hypoxaemia or pseudohypoxaemia.

Various reports of spurious reduction in the PaO<sub>2</sub> values without clinical/radiological evidence of a causative insult have been reported.<sup>[5-7]</sup> They have recommended use of potassium cyanide,<sup>[8]</sup> and sodium fluoride to rapidly inhibit oxygen consumption by cells in the sample, use of plasma instead of whole blood,<sup>[4]</sup> and cooling the specimen in ice immediately after sampling to overcome this problem.<sup>[3,7]</sup> We noticed that placing the sample in ice immediately after sampling still resulted in low PaO<sub>2</sub> values as reported earlier.<sup>[8-10]</sup> For accurate results, rapid analysis of the sample is crucial in such circumstances which can be obtained using Bed-side point-of-care analysers and continuous blood gas analysis.<sup>[6]</sup> However, these gadgets are expensive and hence, alternate methods are devised to overcome this problem.

**Table 1: Serial post-operative ABGs and the corresponding cell counts**

WBC * 10 <sup>3</sup> cells. mm <sup>-3</sup>	Platelets * 10 <sup>3</sup> cells. mm <sup>-3</sup>	FiO <sub>2</sub>	pH	PaCO <sub>2</sub> mmHg	PaO <sub>2</sub> mmHg	HCO <sub>3</sub> mmol. L <sup>-1</sup>
446.4	146.0	0.6	7.37	43.0	56.9	24.4
380.8	140.0	0.5	7.13	69.4	31.7	19

**Table 2: Serial post-readmission ABGs with the corresponding cell counts**

WBC * 10 <sup>3</sup> cells. mm <sup>-3</sup>	Platelets* 10 <sup>3</sup> cells. mm <sup>-3</sup>	FiO <sub>2</sub>	pH	PaCO <sub>2</sub> mmHg	PaO <sub>2</sub> mmHg	HCO <sub>3</sub> mmol. L <sup>-1</sup>
195.8	533.0	0.4	7.30	55.4	50.4	25.7
208.7	358.0	0.4	7.29	51	51	23.8

**Table 3: Serial ABG analysis of samples obtained from precooled syringe and without precooling**

Samples	FiO <sub>2</sub>	pH	PaCO <sub>2</sub> mmHg	PaO <sub>2</sub> mmHg	SaO <sub>2</sub> (%)	HCO <sub>3</sub> <sup>-</sup> mmol <sup>-1</sup>	SBE mmol <sup>-1</sup>	SpO <sub>2</sub>
Precooled syringe	0.4	7.423	42.4	94.2	98.6	27.1	2.6	98
Syringe at room temperature	0.4	7.412	44.7	70.6	94.3	27.8	3.2	98
Syringe at room temperature - 7 minutes delay	0.4	7.398	46.2	51.0	91.2	27.9	3.1	98

We noticed that precooling of the syringe prior to sampling helped reduce the oxygen consumption much more than cooling them after sampling. Precooling will definitely reduce the temperature of sampled blood more rapidly resulting in reliable PaO<sub>2</sub> values.

Pulse oximetry measures oxygen saturation of haemoglobin directly being unaffected by plasma oxygen tension. Hence, normal SpO<sub>2</sub> values confirm pseudohypoxaemia in such conditions and also reliably guides oxygen therapy.<sup>[10]</sup>

We suggest that the entity of spurious hypoxaemia should be familiar among all clinicians who treat patients with leukocytosis and thrombocytosis. All efforts should be made to minimise the time lag in analysing the blood gases and the values should be treated only after correlating clinically. Precooled syringes offer additional solution in efforts to rapidly reduce oxygen consumption by cells in the sampled blood. Pulse oximetry is most useful monitoring tool in diagnosing pseudohypoxaemia and guiding oxygen therapy. Medical management should aim at rapid cytoreduction in blast crisis which would help resolve these management issues.

## References

1. Fox M, Brody J, Weintraub W. Leukocyte larceny: A cause of spurious hypoxemia. *Am J Med* 1979;67:742-6
2. Chishiro T, Suzuki K, Matsuo N. Metabolism of the circulating leukocyte. *Physiol Rev* 1965;45:674-720.
3. Hess CE, Nichols AB, Hunt WB, Suratt PM. Pseudohypoxemia secondary to leukemia and thrombocytosis. *N Eng J Med* 1979;301:361-3.
4. Charan NB, Marks M, Carvalho P. Use of plasma for arterial blood gas analysis in leukemia. *Chest* 1994;105:954-5.
5. Khoo SM, Lee KH, Notley M. Spurious hypoxaemia in a patient with leukaemia and extreme leucocytosis. *Singapore Med J* 2003; 44:208-10.
6. Chen K, Puana RB, Price KJ, Koller CA, Nates JL. The role of point-of-care testing in the early diagnosis of pseudo-hypoxemia in myeloproliferative disorders. *Respir Care* 2010;55:777-9.
7. Schmaier AH. Pseudohypoxemia due to leukemia and thrombocytosis. *N Engl J Med* 1980;302:584.
8. Rello J, Benito S, Triginer C, Net A. False hypoxemia induced by leukocytosis. *Crit Care Med* 1989;16:970.
9. Shohat M, Schonfeld T, Zaizoz R, Cohen I J, Nitzan M. Determination of blood gases in children with extreme leukocytosis. *Crit Care Med* 1988;16:787-8.
10. Loke J, Duffy T. Normal arterial oxygen saturation with ear oximeter in patients with leukemia and leukocytosis. *Cancer* 1984;53:767-9.

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