Increased \( \text{PO}_2 \) Measured in a Patient with Type II Cryoglobulinemia

To the Editor:

We observed an apparent discrepancy in arterial blood gas (ABG) measurements in a patient with type II cryoglobulinemia. The patient, a 70-year-old white woman complaining of fatigue, had prior diagnoses of emphysema and several autoimmune disorders. ABG results from 1993 were consistent with chronic obstructive pulmonary disease (COPD). However, recent ABG determinations (July 6 and July 12, 1994) indicated an increased \( \text{PO}_2 \), even though the patient was not receiving oxygen or hyperventilating. After hospital admission, a diagnosis of type II cryoglobulinemia was made (total protein = 120 g/L, viscosity >2.0 (relative to water), cryoglobulin = monoclonal IgM \( \times \) with polyclonal IgG and IgA). Plasmapheresis was performed on two occasions, reducing the total protein to 70 g/L. Three days after the final plasmapheresis, ABG results on room air were again consistent with COPD and similar to 1993 results (Table 1). The patient's low or low-normal pH results were attributed to renal tubular acidosis, considered to be secondary to the paraproteinemia.

At our institution, ABG syringes (polypropylene with dry heparin) are transported to the laboratory in an ice-water slurry; several minutes elapse before testing occurs. Because the laboratory was initially unaware of the result discrepancy, arterial samples were not saved. However, a sample of serum received for cryoglobulin typing was available. When this serum was chilled in ice for 5 min, it became semigluttonous; sample aspiration was difficult and resulted in formation of air bubbles. (Blood was obtained from this patient only for management purposes; no blood was taken for experimental use.)

One of the most common causes of a falsely increased \( \text{PO}_2 \) is the presence of air bubbles; significant increases in \( \text{PO}_2 \) may occur within 2 min of collection (1). Mueller et al. showed that mixing blood with air bubbles at a low temperature, followed by rapid warming (e.g., by the instrument preheater), resulted in relatively more dissolved oxygen in the liquid phase than if it was mixed with the same air bubble at 37°C (2). In our patient's case, we cannot confirm that an air bubble was present; however, we considered this possibility unlikely because all blood samples were obtained by an experienced pulmonologist and \( \text{PO}_2 \) values greater than that of room air are difficult to explain based solely on the presence of air bubbles.

Artifactual increases in \( \text{PO}_2 \) due to influx of exogenous oxygen through the walls of polypropylene syringes have been reported (3). We cannot, therefore, exclude the possibility that some oxygen diffused into each of our patient's samples. However, because high \( \text{PO}_2 \) values occurred only in samples containing cryoglobulin and because these values were greater than the room \( \text{PO}_2 \), syringe wall permeability cannot completely account for the discrepant results. Another factor that may be partially responsible is that of an increased syringe injection pressure, caused by the cryoglobulin gel-like state. Goeling and Dickson (4) reported that syringes with increased injection pressures may introduce artifactual increases in \( \text{PO}_2 \) of \( \leq 5 \) mmHg. A recent NCCLS document (5) reports that abnormal protein concentrations may cause abnormalities in ABG measurements, although no specific details are given.

Because cooling the patient's serum resulted in rapid precipitation of cryoglobulin, we assume that the same process occurred in the ABG samples. Precipitation may have reduced the solubility of oxygen in this abnormal protein phase, causing a transfer of oxygen to any remaining plasma water. In the closed space of the syringe, this would create an artifactually high \( \text{PO}_2 \). This proposed mechanism would be somewhat analogous to the precipitation of proteins in the process of salting-out (6) because there is less free water available in which the gas can dissolve (7). Although our hypotheses for the abnormally increased \( \text{PO}_2 \) values in the presence of this cryoglobulin cannot be substantiated, we suggest that it may be helpful to process ABG samples containing cryoglobulins without cooling the blood.

References

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Table 1. Arterial blood gas and total protein results.

<table>
<thead>
<tr>
<th>Date of blood sampling</th>
<th>August 2, 1993</th>
<th>July 6, 1994</th>
<th>July 12, 1994</th>
<th>July 18, 1994</th>
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<tbody>
<tr>
<td>( \text{PO}_2 ), mmHg (kPa)</td>
<td>75 (10)</td>
<td>187 (24.9)</td>
<td>165 (22)</td>
<td>79 (10.5)</td>
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<tr>
<td>( \text{PCO}_2 ), mmHg (kPa)</td>
<td>31 (4.1)</td>
<td>24 (3.2)</td>
<td>17 (2.3)</td>
<td>24 (3.2)</td>
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<tr>
<td>pH</td>
<td>7.39</td>
<td>7.37</td>
<td>7.40</td>
<td>7.30</td>
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<tr>
<td>( \text{O}_2 ) sati., %</td>
<td>95</td>
<td>95</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td>Total protein, g/L</td>
<td>N/A</td>
<td>120</td>
<td>120</td>
<td>70</td>
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