Blood Volume and Molybdenum Toxicity in Rabbits

By Jack D. Burke, Ph.D., L. R. Arrington, Ph.D., and G. K. Davis, Ph.D.

In a study of the effects of dietary molybdenum upon the rabbit, a toxic syndrome was produced which was similar to that observed in other species fed excess molybdenum. Anemia was characteristic of the toxicity; low hemoglobin concentration and reduced red cell counts being observed in all rabbits which developed other symptoms of the toxicity. The physiologic action of molybdenum in causing anemia and other abnormalities is unknown. In order further to relate molybdenum to the abnormal blood picture, blood volumes were determined in normal rabbits and in those which were anemic as a result of excess dietary molybdenum.

Table 1.—Blood Volume Data and Molybdenum Toxicity in Rabbits

<table>
<thead>
<tr>
<th>Sex</th>
<th>Wt. (Gm.)</th>
<th>Ration (% Mo)</th>
<th>RBC (10^6)</th>
<th>Hb. (Gm./100 cc.)</th>
<th>T-1824 Dye (cc.)</th>
<th>P-32 (cc.)</th>
<th>Blood Volume (cc./100 Gm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PV RCV TBV</td>
<td>PV RCV</td>
<td>Dye P-32</td>
</tr>
<tr>
<td>f</td>
<td>2280</td>
<td>Control</td>
<td>5.08</td>
<td>12.0</td>
<td>78.5 50.6 129.1</td>
<td>64.3 41.4</td>
<td>105.7 5.66</td>
</tr>
<tr>
<td>m</td>
<td>2289</td>
<td>Control</td>
<td>6.46</td>
<td>14.0</td>
<td>--- --- ---</td>
<td>73.1 42.6</td>
<td>115.7 5.10</td>
</tr>
<tr>
<td>m</td>
<td>2140</td>
<td>0.014</td>
<td>6.29</td>
<td>13.1</td>
<td>68.3 33.8 102.1</td>
<td>--- ---</td>
<td>--- 4.77</td>
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<tr>
<td>f</td>
<td>2230</td>
<td>0.05</td>
<td>6.43</td>
<td>13.0</td>
<td>86.8 48.8 135.6</td>
<td>98.9 55.7</td>
<td>154.6 6.08</td>
</tr>
<tr>
<td>m</td>
<td>1947</td>
<td>0.1</td>
<td>5.54</td>
<td>10.7</td>
<td>91.8 53.7 145.5</td>
<td>96.0 54.8</td>
<td>150.8 7.47</td>
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<tr>
<td>f</td>
<td>913</td>
<td>0.1</td>
<td>0.90</td>
<td>2.0</td>
<td>48.8 2.8 51.6</td>
<td>--- ---</td>
<td>--- 5.65</td>
</tr>
<tr>
<td>f</td>
<td>1825</td>
<td>0.2</td>
<td>3.50</td>
<td>7.3</td>
<td>79.4 21.6 101.0</td>
<td>87.4 24.5</td>
<td>111.9 5.54</td>
</tr>
<tr>
<td>m</td>
<td>1255</td>
<td>0.2</td>
<td>1.20</td>
<td>3.2</td>
<td>70.6 7.8 78.4</td>
<td>--- ---</td>
<td>--- 6.24</td>
</tr>
</tbody>
</table>

RBC = red blood cells; Hb. = hemoglobin; PV = plasma volume; RCV = red cell volume; TBV = total blood volume.

Methods

Data were obtained from three anemic rabbits and from five other rabbits which were essentially normal with respect to hemoglobin concentration and erythrocyte values (table 1). The anemic rabbits exhibited other abnormalities in addition to anemia, while the control rabbits and three of those receiving low levels of molybdenum were free of any abnormalities.

Determinations of the blood volume were made using modifications of the T-1824 (Evans's blue) dye method of Gregersen and the P³² method of Hevesy and Zerahn and Hevesy et al. Both procedures were employed concurrently with some of the animals; in others only one of the methods was used (table 1). The animals were given ether anesthesia and both jugular veins were exposed. The dye and P³² labeled red blood cells were injected into one of the veins and blood samples were withdrawn from the opposite vein at five and ten minute intervals. Calculations were based upon data obtained from these samples. Hahn and Hevesy have demonstrated that two and one-half minutes is sufficient time for mixing of P³² labeled red blood cells in the blood of rabbits.

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Results

Data representing the hemoglobin concentration, red blood cell count, plasma volume, red cell volume, total blood volume, and blood volume per 100 Gm. of body weight are presented in table 1. The blood volume of the anemic rabbits, per unit of body weight, was not different from those which were normal with respect to the blood picture and other evidences of toxicity. In all of the animals, including the anemic rabbits, blood volumes were comparable to values (mean 5.9, range 4.7 to 7.0 cc. per 100 Gm.) reported by other investigators. Although the total red cell volume was abnormally low in the anemic rabbits, a higher total plasma volume accounted for the normal blood volumes observed in this experiment.

Summary and Conclusion

The blood volume of normal rabbits and rabbits anemic with molybdenum toxicity was determined using the dye and P32 methods. The blood volume per unit of body weight was found to be within the normal range indicating that rabbits were able to maintain normal blood volume even though anemic as a result of molybdenum toxicity.

References

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